B L I S T E R R U S T W O R K

I N T H E F A R W E S T

January 1 to December 31, 1931

Spokane Branch
Division of Blister Rust Control
618 Realty Building
Spokane, Washington



A large area of overmature white pine type eight miles southeast of Elk River, Idaho. This photograph, taken by the 116th Photo Section, 41st Division, Washington National Guard, distinctly shows the character of the local clearing, made by homesteaders, and seeding back to white pine reproduction. Such openings in the forest canopy frequently contain many more Ribes than the timbered area, and their location is of great importance in Ribes eradication.

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BLISTER RUST WORK IN THE FAR WEST

January 1 to December 31, 1931

* * * * * * * * * * * * * * *

INTRODUCTION

Practical operations in white pine blister rust control in the far West were continued during 1931 on a somewhat larger scale than during 1930. Additional allotments of funds by the Clearwater Timber Protective Association and Priest Lake Timber Protective Association, and by a local group of owners in the vicinity of Clarkia, Idaho, considerably augmented the volume of work. Also the allotment of $195,000 to operations on national forest lands, as against $25,000 in the previous year, made possible a greatly increased program by the Forest Service.

While the work has largely consisted of a continuation of the stream type Ribes eradication program, in several instances this method of attack was varied to include the working of upland areas containing heavy concentrations of Ribes. This scheme of operation was used on the national forests; in the Potlatch Timber Protective Association several areas of upland type surrounding heavy pine infections were worked; and in the vicinity of Clarkia, Idaho a system similar to that on the national forests was put into effect. This method constitutes an extension of the basic idea involved in the stream type Ribes eradication program to include all heavy concentrations of Ribes irrespective of their location and relation to the stream bottoms. In general, it was necessitated by the rapid rate of intensification of the rust in north Idaho.

During 1931, 46 pine infection centers were discovered in the Inland Empire in addition to the 15 already known to exist. In several instances the rust has shown an alarming tendency to intensify to an unexpected degree upon Ribes lacustre and R. viscosissimum, species hitherto considered relatively low in susceptibility. The presence of this large number of infection centers coupled with the tendency of the disease to use all Ribes species as infective hosts will necessitate a more drastic departure from the stream type Ribes eradication program than was earlier contemplated.

Experimental Ribes eradication in the sugar pine belt in California was continued in 1931 by an initial operation upon the Lassen National Forest. This area proved to be relatively low in Ribes, resulting in per acre costs considerably lower than those secured upon other forests. During the course of this operation, however, it was recognized that R. inerme would constitute a problem of extreme difficulty, possibly of major importance in control work over the northern part of California.

The following tabular arrangement has been set up to show the yearly relation between the rate and spread of the rust over northwestern United States, and the development of the Western control program:

Yearly Progress

Year	The Rust	The Work
1922	Found in Puget Sound region of Washington and interior of British Columbia	Largely confined to scouting for the disease, cultivated black currant eradication in western Washington and quarantine inspection. A very small experimental Ribes eradication operation carried on at Elk River, Idaho.
1923	General spread of the rust over dry belt of B.C. and into north central Washington. First Ribes infection found at Nelson, B.C.	Extension of cultivated black currant eradication program to Montana, Idaho, Oregon and California. Small experimental Ribes eradication project on Priest River Experiment Station. Beginning of reconnaissance.
1924	Practically no spread of the rust.	Satisfactory development of cultivated black currant eradication program. Larger experimental Ribes eradication project in Upper Priest River valley. Reconnaissance applied over north end of Kaniksu National Forest.
1925	Extension of rust into northwestern Oregon Ribes infection found over area 20 miles in extent, east and west in the general vicinity of Nelson, B.C.	Completion of cultivated black currant eradication in Oregon. Satisfactory progress in other states. Reconnaissance extended to the Coeur d'Alene National Forest and to lands of private timber owners of North Idaho. Further experimental Ribes eradication in Upper Priest River valley and new project on Crater National Forest, Oregon.
1926	Development of pine infection on Olympic Peninsula and in vicinity of Nelson, B. C. No further spread of Ribes infection.	Completion of cultivated black currant eradication in Montana. Special development of reconnaissance methods, resulting in much more rapid work. Experimental Ribes eradication in West Branch region of Kaniksu National Forest results in material lowering of costs, by developing of scouting methods. Experimental work shows feasibility of chemical eradication. Experimental Ribes eradication started in California. Clearer conception gained of ecology project. Quarantine 63 put into effect.

Year	The Rust	The Work
1927	Further development of pine infection on Olympic Peninsula and new infections found in Puget Sound region. Ribes infection generally prevalent in Washington west of the Cascades, scattered in eastern Washington. First Ribes infection found in north Idaho.	Completion of cultivated black currant eradication in Idaho and Washington. Control reconnaissance placed on a practical basis in Idaho and California. Experimental Ribes eradication conducted on the Coeur d'Alene National Forest in Idaho and the Stanislaus National Forest in California with results indicating feasibility of application of local control. Considerable progress made with experiments in chemical eradication. Development of power equipment begun for application of chemicals. Ribes ecology project initiated an enlarged program of studies and controlled plots. Quarantine regulations maintained.
1928	New pine infections located in northeastern Washington and in the Mt. Hood region in northwestern Oregon. Ribes infection generally distributed over the white pine region of north Idaho, extended east of the Cascades in Washington, farther south in Oregon and into western Montana.	Cultivated black currant eradication continued in California. Control reconnaissance conducted on national forests and private lands in Montana, Idaho and California. Experimental hand eradication of Ribes carried forward on the Coeur d'Alene National Forest in Idaho, Mt. Hood National Forest in Oregon, and Stanislaus National Forest, California. A protective zone was established around Wind River Forest Nursery in Washington. Application of cooperative local control initiated on Priest Lake Timber Protective Association in north Idaho. Studies of methods of hand pulling and chemical eradication of Ribes resulted in materially lowering of costs by increasing efficiency and speeding up work. Reeradication studies conducted on areas in Idaho originally worked in 1926. Chemical eradication of Ribes consisted of laboratory and field experiments with spray formulae, methods of application and type of spraying equipment. Ribes ecology studies in Idaho were continued and new studies of soil temperature and soil moisture were established. Ribes ecological studies initiated in California. Preeradication survey conducted on Plumas National Forest in California and on stream type in Musselshell district of Clearwater National Forest in Idaho. Quarantine regulations maintained.

Year	The Rust	The Work
1929	Three pine infection centers located near the southern end of white pine region in Idaho, four new centers located on Mt. Hood National Forest, Oregon. New Ribes infection located in northwestern Montana, and extension of infections in Oregon including one in southwestern Oregon	Cultivated black currant eradication continued in California. Control reconnaissance performed on Lassen National Forest, California. Experimental hand eradication conducted at the Savenac Nursery at Haugan, Montana; on the Plumas National Forest in California; and the Peavy Arboretum in Oregon. Experimental chemical eradication by power spraying conducted on the Clearwater National Forest in Idaho. Cooperative local control extended to the Clearwater and Potlatch timber protective associations in Idaho. A field study of methods of chemical eradication carried on in California during winter resulted in more efficient equipment, development of knapsack spraying methods and training permanent personnel. Chemical reeradication performed in Idaho and hand reeradication on the Coeur d'Alene National Forest in Idaho and Wind River Nursery in Washington. Tests of Ribicides were made at various locations in Idaho, Oregon and California and Laboratory investigations were instituted at Berkeley, California. Experimental application of Ribicides at Clarkia, Idaho tested effectiveness of sprays and seasonal toxicity. Ribes ecology studies conducted in Idaho, Oregon and California furnished additional findings of value. Plot studies to observe effectiveness of control were initiated at Newman Lake and Long Meadow Creek in Idaho and at Rhododendron, Oregon. Preeradication surveys were conducted on the Clearwater National Forest and Clearwater and Potlatch timber protective associations in Idaho, and the Plumas National Forest in California.
1930	Eleven new pine infections located in the southern portion of the Idaho white pine region and two	Cultivated black currant eradication completed in California. Control reconnaissance conducted on Eldorado National Forest, California. Experimental Ribes eradication carried on at the Wind River Nursery in Washington and on the Mt. Hood National Forest in Oregon. Cooperative local control conducted near Flathead Lake in Montana, on the Clearwater and Potlatch timber protective associations and the Clearwater National Forest in Idaho and Mr. Rainier National Park in Washington. Reeradication carried on at the Savenac Nursery in Montana and on the Stanislaus National Forest in California. A study comparing knapsack and power spraying in Idaho gave results favoring the knapsack. Investigations

Year	The Rust	The Work
1930 continued	located in Oregon, these latter marking a continued southern spread. New Ribes infections located in Montana and Oregon indicated further spread; locations in Idaho in region generally infected.	initiated to develop chemicals toxic to barberry. Development and testing of Ribicides continued in the laboratory, greenhouse and field, giving definite results valuable to the control program. Ribes ecology studies continued in Idaho gave further results including Ribes seed germination data. Ecological studies in California furnished further information on Ribes establishment, growth and fruiting habits. Studies on effectiveness of control carried on at Newman Lake and Pysht in Washington and Cheekye, British Columbia. Preeradication surveys conducted in anticipation of future control work.
1931	Forty-five new pine infection centers located in Idaho, two in Washington and one in Oregon, none of which marked any spread to new regions. Ribes infections found in Washington and Oregon indicated no further extension of the rust.	Control reconnaissance conducted on Mount Rainier National Park, Washington, on federal and private lands in Oregon, and on the Klamath National Forest in California. Experimental Ribes eradication carried on at the Wind River Nursery in Washington and on the Lassen National Forest in California. Cooperative local control conducted on the Clearwater, Potlatch and Priest Lake timber protective associations, the Upper St. Maries River and the Clearwater National Forest in Idaho, Mount Rainier National Park in Washington and Mt. Hood National Forest in Oregon. Efficiency of Ribes eradication work checked on the Clearwater and Potlatch timber protective associations and the Clearwater National Forest. Studies continued regarding hand and chemical eradication methods, experimental and field equipment, and brush elimination as a means of permanent Ribes suppression. Definite results obtained in development of chemicals toxic to barberry. Control program further benefited by development and testing of Ribicides. Ecological studies conducted in Idaho and California included establishing new studies and obtaining further results from old studies. Pine infections studied on five areas in Idaho and one in Washington. Preeradication surveys conducted in advance of contemplated control work.

During the calendar year 1931, the Western Branch of the Division of Blister Rust Control operated upon the basis of funds available from two federal fiscal years as follows:

For the period January 1, 1931 to June 30, 1931, the applicable appropriation was "31133.14. Salaries and Expenses, Bureau of Plant Industry, Blister Rust Control, 1931" in the amount of $238,195 (for the entire fiscal year 1931) allotted as follows:

Project		For the Period 7/1/30 to 6/30/31
A. Delaying spread of blister rust		
1. Field surveys in northwestern states to determine location of dangerous centers of infection and to follow the natural advance and establishment of blister rust in the northern area		$17,718.32
2. Field surveys in Oregon		2,600.00
3. Field surveys in California		4,820.00
B. Development of application of local control		
1. Federal lands in Washington, Idaho and northwestern Montana		27,092.62
2. Local control on state and private lands in Idaho, two dollars for one dollar cooperation between Federal Government and timber owners		40,000.00
3. Local control on state lands, Montana		1,000.00
4. Studies of local control and recheck of previously eradicated areas, Oregon		5,345.00
5. Studies of local control and its costs in California		12,212.00
6. Control reconnaissance and Ribes survey, California sugar pine areas		5,689.00
C. Investigative work, Division of Forest Pathology		22,155.00
D. Experimental work on chemical eradication of Ribes and studies on Ribes ecology		39,461.66
E. Educational work		5,950.00
F. Field supervision, maintenance of Spokane office, miscellaneous supplies		27,526.40
G. Miscellaneous		
General control	$19,710.00	
Mycology	550.00	
2% Departmental Reserve	2,200.00	
1% Bureau Reserve	2,165.00	
Special Treasury Reserve	2,000.00	26,625.00
Total		$238,195.00

In addition to the allotments shown above the sum of $16,758 was made available for Western blister rust control use in June, 1931, from funds originally allotted for Eastern blister rust control work and by the release of appropriation reserves. The sum of $5,167.68 from the available $50,000 deficiency appropriation "31/2133.14 Salaries and Expenses, Bureau of Plant Industry, Blister Rust Control, 1931-1932" was also expended for blister rust control work in Idaho during June, 1931.

From the appropriation "31133.25, Salaries and Expenses, Bureau of Plant Industry, Barberry Eradication, 1931" the sum of $6,500 for the entire fiscal year 1931 was allotted to the Western Branch of the Division of Blister Rust Control for experimental work in the eradication of barberry by chemicals. This work was conducted in connection with the experimental work on the chemical eradication of Ribes.

From July 1, 1931 to December 31, 1931 the applicable appropriations were "32133.14 Salaries and Expenses, Bureau of Plant Industry, Blister Rust Control, 1932" in the amount of $239,015 (for the entire fiscal year) and "31/2133.14 Salaries and Expenses, Bureau of Plant Industry, Blister Rust Control, 1931-1932" in the amount of $50,000 (for the period April 1, 1931 to June 30, 1932). In addition, $6,500 from the available appropriation "32133.25 Salaries and Expenses, Bureau of Plant Industry. Barberry Eradication, 1932" was originally allotted to the Western Branch Division of Blister Rust Control for the entire fiscal year 1932, for experimental work in the eradication of barberry by chemicals. The total amount of $295,515 was originally allotted as follows:

Project		For the Period 7/1/31-6/30/32
A. Delaying spread of blister rust		
1. Field surveys in northwestern states to determine location of dangerous centers of infection and to follow the natural advance and establishment of blister rust in the northern area		$19,922.00
2. Field surveys in Oregon		1,250.00
3. Field surveys in California		3,350.00
B. Development and application of local control		
1. Federal lands in Washington, Idaho and northwestern Montana		38,405.00
2. Local control on state and private lands in Idaho, two dollars for one dollar cooperation between Federal Government and timber owners		83,850.00
3. Studies of local control and its costs in California		20,175.00
4. Control reconnaissance and Ribes survey, Oregon		6,250.00
5. Control reconnaissance and Ribes survey, California sugar pine areas		6,000.00
C. Investigative work, Division of Forest Pathology		22,155.00
D. Experimental work on chemical eradication of Ribes and barberry and studies in Ribes ecology		36,598.00
E. Educational work		6,000.00
F. Field supervision, maintenance of Spokane office, miscellaneous supplies		26,980.00
G. Miscellaneous allotments		
1. General control	$19,710.00	
2. Mycology	500.00	
3. Departmental reserve	2,200.00	
4. Bureau reserve	2,170.00	24,580.00
Total		$295,515.00

These allotments are subject to change before the end of the fiscal year owing to the fact that the actual amount estimated as available from the $50,000 deficiency appropriation during the current fiscal year has been reduced by a special Treasury reserve of $14,200 and by $5,167.68

expended from this appropriation during June 1931. A $2,000 reduction has also been made in the original barberry allotment, this amount having been made available for the Division of Barberry Eradication for current use. Additional expenditures not provided for in the original allotments were also incurred in the amount of $6,865.73 for Ribes eradication at Still Creek, Oregon, Mt. Hood National Forest, and in the amount of $1,805.55 for the summarization of field data during the period July 1, 1931 to December 31, 1931.

The organization of the work and the grouping of personnel followed the system in use in 1930. The majority of the employees were permanently headquartered at Spokane and were at the Spokane office when not engaged upon field assignments. The only exceptions to this general rule were in the cases of men whose special duties made it necessary for them to work elsewhere. The following is the permanent western personnel which was employed during the period covered by this report:

1. Supervisory

a. In Charge of Western Branch Office, S. N. Wyckoff, Senior Pathologist.

2. Project Leaders

a. Ribes Ecological Studies. C. W. Waters, Agent, full time summer months, w.a.e. during the winter period.

b. Development of methods of Ribes eradication, *C. C. Strong, Associate Forester assisted by H. E. Swanson, Agent, C. H. Johnson, Associate Pathologist, and J. F. Breakey, Agent.

c. Cooperative Local Control, Idaho. *C. C. Strong, Associate Forester, assisted by B. A. Anderson, W. G. Guernsey and H. J. Hartman, Junior Foresters; H. E. Swanson, F. O. Walters, L. L. White, N. D. Nelson, H. F. Geil and G. M. Whiting, Agents.

d. Cooperative Local Control and Control Reconnaissance, National Parks, Washington. *C. C. Strong, Associate Forester, assisted by M. C. Riley, Junior Forester.

e. Cooperative Local Control, Oregon, L. N. Goodding, Associate Pathologist, assisted by B. A. Anderson, Junior Forester and R. L. MacLeod, Agent.

*For the purpose of coordination and standardization of the various eradication projects (b, c, and d) in the Inland Empire white pine belt, these were all placed under the supervision of C. C. Strong, Associate Forester.

f. Educational Work, Kermit Miller, Agent, assisted by Miller Cowling, Agent.

g. Studies on Spread of the Rust and Damage to Pine, E. L. Joy, Junior Forester, assisted by R. E. Myers, F. F. Staat and C. M. Chapman, Agents; H. N. Putnam, Associate Pathologist transferred to Middle West July 1, 1931.

h. Experimental Chemical Eradication of Ribes and Barberry.
H. R. Offord, Agent, assisted by C. R. Quick, Junior Microanalyst, R. P. d'Urbal, Assistant Chemist; G. R. Van Atta, G. E. Draper, R. W. Vance, L. S. Keyser and J. A. Vogtmann, Agents, and Miss Frances Greenfield, Junior Clerk, Stenographer.
Mrs. I. E. Webber, Agent (resigned June 30, 1931).

i. Summarization of field data, H. P. Barss, Agent during summer and Collaborator during winter period, assisted by F. P. Sipe, Agent, during summer and Collaborator during winter period.

3. State Leaders

a. Montana, C. H. Johnson, Associate Pathologist.

b. Oregon, L. N. Goodding, Associate Pathologist, assisted by Miss D. L. Anderson, Agent.

c. California, G. A. Root, Associate Pathologist, assisted by project leader W. V. Benedict, Assistant Forester, with his assistants, T. H. Harris and R. Blomstrom, Junior Foresters (Reconnaissance). D. R. Miller, Junior Forester (Eradication); F. A. Patty, Assistant Pathologist (Ribes Ecology); stenographic work performed by Miss M. J. Preitkis, Agent.

4. Clerical Work

R. L. MacLeod, Agent, assisted by A. H. Glasgow, Agent
Miss M. L. McWold, Senior Clerk and Temporary Special Disbursing Agent, assisted by Mrs. E. M. Jump and Mrs. M. C. Dowdy, Clerks.
Mrs. L. E. Klatt, Clerk, assisted by Mrs. E. K. Anderson, Junior Typist, Miss M. V. Lynch, Under Clerk-Typist, Miss C. Ryan, Junior Clerk-Stenographer, and Miss M. Storaasli, Junior Stenographer.

5. Collaborators

H. P. Barss, Corvallis, Oregon.
Dr. J. P. Bennett, Berkeley, California

Dr. Carl C. Epling, Los Angeles, California.
A. O. Garrett, Salt Lake City, Utah.
Dr. T. H. Goodspeed, Berkeley, California.
Dr. D. R. Hoagland, Berkeley, California.
Dr. E. E. Hubert, Moscow, Idaho.
B. O. Longyear, Ft. Collins, Colorado.
Rutledge Parker, Missoula, Montana.
F. P. Sipe, Corvallis, Oregon.

BLISTER RUST CONTROL WORK IN MONTANA
1931

Blister rust control activities in Montana were continued as a cooperative project between the Bureau of Plant Industry and the Montana Department of Agriculture, the Montana Forestry Department, the School of Forestry, University of Montana, the Northern Montana Forestry Association, and the Blackfoot Protective Association. There is given below the amendment to the basic memorandum of understanding, which was drawn up to cover the cooperative work for the fiscal year 1932 beginning July 1, 1931:

AMENDMENT TO
MEMORANDUM OF UNDERSTANDING
Effective July 1, 1927

Between
THE UNITED STATES DEPARTMENT OF AGRICULTURE, BUREAU OF PLANT INDUSTRY
and the
MONTANA STATE DEPARTMENT OF AGRICULTURE - - - MONTANA STATE FORESTRY DEPARTMENT - - - THE SCHOOL OF FORESTRY, UNIVERSITY OF MONTANA - - - and the NORTHERN MONTANA FORESTRY ASSOCIATION

Cooperative work in Controlling White Pine Blister Rust
in
MONTANA

* * * *

Paragraph F-6 of the Memorandum of Understanding described above contains the following:

> "For the fiscal year 1928, the Bureau of Plant Industry shall contribute in value approximately $6,000, the Montana State Department of Agriculture approximately $5,000, the Montana State Forestry Department approximately $1,200, the School of Forestry, University of Montana, approximately $300, and the Northern Montana Forestry Association shall contribute in value approximately $1,000; thereafter the amount to be contributed by each shall be determined and agreed upon by supplemental correspondence."

In accordance with the foregoing provision, it is mutually agreed that the Blackfoot Protective Association will be added to these

agencies who are cooperating to secure the control of white pine blister rust in Montana and that for the fiscal year ending June 30, 1932, there will be contributed in value by the Montana State Department of Agriculture approximately $4,000, by the Montana State Forestry Department approximately $1700, by the School of Forestry, University of Montana, approximately $300, by the Northern Montana Forestry Association approximately $1000, by the Blackfoot Protective Association approximately $1000; and by the United States Department of Agriculture, Bureau of Plant Industry, through its Division of Blister Rust Control, approximately $7000, in connection with cooperative blister rust control work in Montana.

DATE:	SIGNATURE:
9/29/31	(s) A. H. Stafford Commissioner, Montana Department of Agriculture
12/21/31	(s) Rutledge Parker State Forester, Montana Forestry Department
1/4/31	(s) T. C. Spaulding Dean, School of Forestry, University of Montana
11/19/31	(s) A. E. Boorman Secretary, Northern Montana Forestry Association
12/24/31	(s) Roscoe Haines Secretary, Blackfoot Protective Association
1/28/32	(s) Wm. A. Taylor Chief, Bureau of Plant Industry

BRUSH ELIMINATION AS A MEANS OF PERMANENT RIBES SUPPRESSION

By
C. H. Johnson
Associate Pathologist

INTRODUCTION

Brush elimination as a means of permanent Ribes suppression for the control of white pine blister rust was started at Savenac Nursery about midseason of the year 1929. Actual control operations, however, were inaugurated in 1928, and consisted of treating Ribes petiolare and R. inerme by applying toxic chemicals in spray form to heavy concentrations and hand pulling the lighter concentrations and scattered bushes. The spray proved very effective on R. petiolare, but was less so with R. inerme. It was recognized that the hand pulling method of removing this species was too slow, expensive, and ineffective to be practical, and that some new method must be given a trial.

Various means of treating brush followed by burning were decided upon as temporary expedients. Random spraying followed by broadcast burning was the first method adopted to eliminate all brush, and cutting and piling brush was next attempted. Broadcast burning without spraying and supplemented by brush cut and piled in windrows was tried with the express purpose of arriving at a reduced cost of destroying brush. This operation was started with hand labor and developed into the use of machinery which performed every phase of brush work effectively and efficiently. In addition the danger of burning brush and debris was reduced, because this accumulation could be disposed of at a time when burning is absolutely safe.

Following the clearing of brush from an area, grass seed was sown to reclaim areas and prevent the recurrence of brush, the object at all times being to give the grass seed and equal chance to compete with other seed which would naturally, if given full sway, again reproduce the original flora. Stands of grass formed by artificial seeding since 1929 are indicative of what can be accomplished.

It is felt that methods employed at the Savenac Nursery will be applicable to similar and quite extensive areas of brush and Ribes which occur along streams in the white pine region.

LOCATION AND DESCRIPTION OF AREAS

The work was conducted at the Savenac Nursery on the Cabinet National Forest near Haugan, Montana, along the St. Regis River, Savenac Creek, Big Creek, Timber Creek, and Dry Creek, and on the Coeur d'Alene

National Forest in Idaho along the Little North Fork at the junction of Picnic Creek and Tepee Creek in the vicinity of the Magee Ranger Station. The Montana and Idaho areas were very similar with respect to the occurrence of heavy concentrations of R. inerme. Both areas contain beaver workings and present about the same general working conditions for conducting Ribes eradication by suppression methods.

METHODS EMPLOYED

A. Destruction of Brush and Ribes by Burning.

Ribes suppression is the object of brush destruction. The methods employed have constantly changed from year to year, and each step has been an attempt to arrive at some practical working method. A brief description of methods used to eliminate brush is as follows: (1) In 1929 spraying followed by broadcast burning was the first method adopted to eliminate brush and suppress Ribes. A 20 per cent solution of $NaClO_3$ instead of being directed entirely at Ribes bushes was applied to all species of brush, grass and to the ground, and the area fired. Brush litter and duff were readily consumed. Broadcast burning at this season of the year was extremely hazardous. (2) Cutting and piling brush was attempted in 1930, since more uniform destruction of brush and better regulated burning were essential. It was thought this might be obtained by cutting, piling and burning during the regular brush burning season. The cost of this operation was prohibitive and threatened to defeat the very purpose of the work. (3) Lopping brush, broadcast burning of brush in place without previous preparation, and construction of windrows to burn chemically treated as well as untreated brush in place.

The plan of operation for 1931 called for spraying, and from partial to complete lopping and scattering of the remaining heavy clumps of brush in the vicinity of Savenac Nursery. In early April this plan was put into effect, but after operating for approximately ten days it was demonstrated that standing brush could be killed and partially eliminated without any preparation. Lopping and scattering of brush was discontinued and windrows consisting of cut and piled brush were placed on the windward side of clumps and stretches of standing brush. (See photograph showing a well constructed windrow.) One of the purposes of the windrows was to serve as a starting point in burning and to generate sufficient heat when ignited to sweep through and destroy standing brush. The primary object, however, was to reduce the cost of cutting and handling brush. Where unbroken stretches of brush occurred, particularly on Upper Savenac and lower Big Creek, the following combination of methods was used: (1) complete spraying of brush without windrowing; (2) complete spraying of brush with windrows constructed at intervals of 150 to 300 feet; (3) construction of windrows at intervals of 150 to 300 feet without any spraying of brush.

A five per cent solution of sodium chlorate was used in spraying the brush preparatory to burning.

B. Destruction of Brush and Ribes by Use of Machinery

On August 7, a 40 horsepower Caterpillar tractor equipped with a bulldozer, a piece of machinery used in clearing land and for road construction work in mountainous regions, was tried out on Dry Creek near the Savenac Nursery. A similar machine was later employed near the Honeysuckle Ranger Station on the Coeur d'Alene National Forest, to remove concentrations of Ribes and brush from stream bottoms. At the beginning of operations all brush and logs were pushed to the edges of the stream type, but later the brush was pushed from the edges toward the center of the stream type area, thus forming rows of brush ready to be burned and leaving the mineral soil exposed on both sides of the brush piles.

The 40 horsepower caterpillar tractor appears to have sufficient power to handle all brush and windfall generally encountered in the stream bottoms. On Dry Creek a saw crew made a cut in the larger windfalls in order that the operation of the machine would not be retarded. The Caterpillar works rapidly moving backward and forward and constantly maneuvering for a more favorable working position.

Heavy concentrations of R. inerme on rather dry sites seem to offer most favorable working conditions for a bulldozer-equipped Caterpillar tractor. A heavy boggy stream bottom will make operations difficult. Sufficient work has not been performed to determine the working limitations of the tractor in stream type eradication. If upon further experimentation with this machine or other heavy machinery, it is proven that stream type areas can be quickly converted to areas suitable for grazing or other purposes, the possibility of securing cooperation for Ribes eradication and control work undoubtedly will be greatly enhanced.

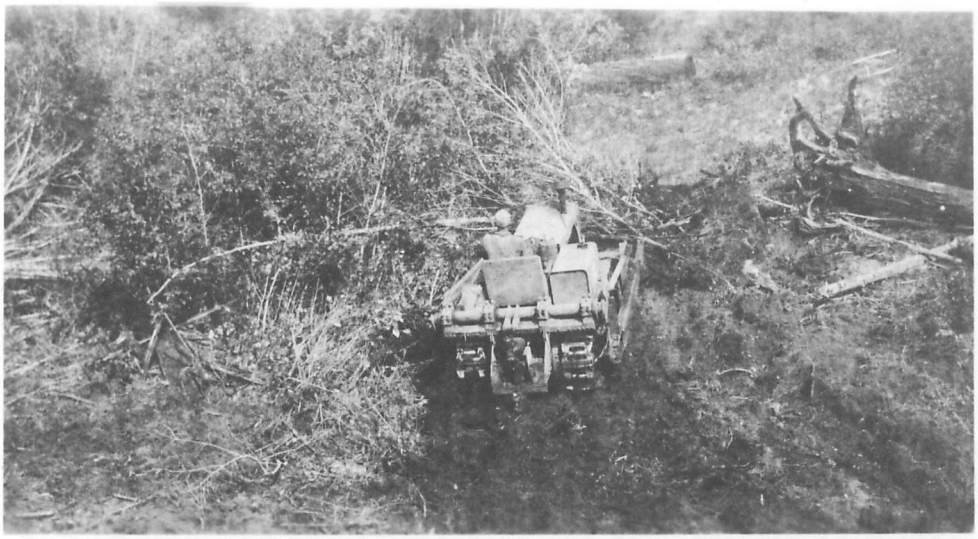
RESULTS

A. Clearing and Burning

1. Savenac Nursery

a. With previous experience. The spraying of Ribes and brush which was followed by burning in 1929 proved to be the most efficient work in brush suppression where hand methods were employed. Most satisfactory duff burns were obtained, and almost impenetrable thickets of brush and Ribes were cleared. The areas were made readily accessible for reeradication and the soil was in shape to support a new crop.

Any advantage to be gained through cutting and piling brush is offset by the extreme cost of the operation. The brush cut and piled along the St. Regis River and on Big Creek was burned in late August and early September, 1930. Conditions were ideal for burning and a uniform



Trenching the edge of the stream type brush.



Windrows constructed to burn blocks of standing brush.



Following bulldozing operations an area is ready for grass seeding.

destruction of brush cover resulted. Very little resprouting from cut brush or establishment of annual weeds took place the following year. On Savenac Creek the brush cut and piled in 1930 was burned in April, 1931. This area is wet and boggy especially on former R. petiolare sites. The brush burns were satisfactory but duff was left practically undisturbed and as a consequence, considerable sprouting of brush occurred and weeds appeared. A large portion of this area will, however, burn readily in April or May, 1932, because the winter snows will have pressed dry weeds and grasses to the ground.

Lopping and scattering brush and windrowing belong in the same category. In both methods the aim is destruction of brush and a ground burn. Early spring and possibly during the fall are the only safe periods for burning, consequently the degree of success attained in securing duff burns depends upon weather conditions. Windrowing involves less hand labor. A windrowed area could be burned over three or more times before approaching the costs involved in complete lopping and scattering of the brush.

Tests made during the late summer and early fall indicate that firing windrows to destroy brush is equally as effective as burning lopped and scattered brush. Unless the brush is dense and placed compactly it is difficult to fire. A breeze is essential. A windrow fired under the same conditions will generate sufficient heat to readily burn adjoining brush.

One hundred pounds of sodium chlorate in spray from was applied to less than half an acre of lopped and scattered brush to prepare the area for burning and seeding. A burn was attempted on October 3 with favorable conditions prevailing. The burn was irregular. A windrow burned about mid-October without chemical treatment or scattering of brush left that area in equally as good shape for seeding and with less debris on the ground. Early spring burning of windrowed, lopped and scattered brush has not yet been attempted.

Approximately one-quarter acre of brush favorably located for a thorough burn and sprayed in August, 1931, was fired on September 30 of the same year. The fire was started in dry grass at the edge of the sprayed area. A wind was blowing and in approximately thirty minutes, all brush on the area was consumed. The fire was so severe that it became necessary to trench and apply water to prevent a dangerous fire. Due to the fire hazard it seems doubtful whether areas sprayed with a chemical solution can be fired until that solution becomes impotent. Extensive burning of brush in place will not be undertaken until early spring.

The following table shows the costs of various methods of treating brush preparatory to burning:

TABLE NO. 1

COSTS OF TREATING DENSE PATCHES OF BRUSH
BY VARIOUS METHODS

Drainage	Method	Acreage Worked	Man Days	Labor Costs	Cost of Chemicals	Total Cost	Cost Per Acre
Savenac and Big Creeks	Spraying Entire Brush Cover	24	90¾	$330.77	$136.75	$467.52	$19.48
Savenac and Big Creeks	Windrowing	40	111	433.25	-	433.25	10.83
Dry Creek	Lopping, Scattering Partial Cutting and Piling	12	32	111.25	-	111.25	9.27

On Savenac and Big creeks, beaver dams had to be opened and drained before spraying could be completed.

b. Burning without preparation. Conditions from April 18 to May 1, 1931, were favorable for burning. Isolated patches of brush along the St. Regis River were burned by lighting dry grass and depending on a wind to fan the flames. At a number of locations the understory of brush was consumed as well as the overstory of willow. The initial cost of this method of burning is light. A second and possibly a third burn will be necessary to destroy the duff but such areas become accessible after the first burn. The success of this method of burning led to the construction of windrows.

The following tabulation is intended to show the nature of certain lines of work and to furnish information as to how and where funds were expended.

TABLE NO. 2

RESULTS OF CLEARING AND BURNING, SAVENAC NURSERY

Description of Work	Location	Acreage Worked	Cost of Labor	Cost Per Acre
Windrowing, lopping and scattering, cutting and piling brush.	St. Regis River	240	$429.86	$1.79
Brush burning	Savenac Creek	32	62.12	1.94
Land clearing and preparing soil for a turf on a dangerous Ribes site.	East Fork Savenac Creek W.W.Cameron land	2	50.00	25.00
Eradication of Ribes in dense brush, April 22,1931	Upper Savenac Creek	15	11.25	0.75
Windrowing, lopping and scattering and piling brush	Timber Creek	4	60.00	15.00
Clearing a fire break between slope and stream type to reduce fire hazard	Upper Savenac Creek	3	77.80	25.93
Labor engaged on brush work *during bulldozing operation	Dry Creek	3	16.00	5.33
Preparation of seed beds for Kephart's seeding plan.	St. Regis Creek and Dry Creek	3	64.70	21.57

The windrowing on the St. Regis River was done largely on previously burned areas.

*Men worked over 3 acres, bulldozer 2-1/2 acres.

2. Coeur d'Alene National Forest.

Windrowing conducted on the Coeur d'Alene National Forest was exactly the same as that performed on Savenac Creek with a single exception. The work was started on the 10th of August and immediately afterward the men were called for fire duty. This affected the spraying work. Defoliation of R. inerme and willow had reached an advanced stage when the spray was being applied and as a consequence spraying work was curtailed.

A sum of $400.00 was allotted for the work. Windrows, as designated below, were constructed:

Tepee Creek (vicinity of Magee Ranger Station).....1,655 linear feet
Tepee Creek (at junction of Riley Creek).....1,200 " "
Little North Fork (vicinity of Honeysuckle).....2,015 " "
Total.....4,870 " "

The acreage covered by windrows has not been measured. Spring burning is recommended.

B. Brush Destruction by Machinery.

1. Savenac Nursery

Over an area designated as heavy brush, medium in windfall and semi-boggy, the tractor and bulldozer worked remarkably well. On a dry site a 100 per cent clearing job resulted (see photograph). On moderately wet sites the brush was pushed toward the center of stream type thus forming windrows. On extremely boggy sites great caution was exercised. The Caterpillar at times sank so that it could not go ahead, but each time it backed out without difficulty, causing no delay in operation. After working one and one-half days the machine advanced 42 chains down the creek, at which point lopped and scatter brush were encountered. The Caterpillar then returned up the creek to the starting point and proceeded to work in a heavy bog where the slope rose abruptly from the edge of the stream type brush. Here results were not so satisfactory. The Caterpillar became mired, and difficulty was experienced in moving backward and up the slope.

In two days the tractor worked over approximately two and one-half acres of difficult stream type brush. Costs are not available. It required two days moving time to deliver and return the machine. All time and expenses involved were charged to the Savenac operation.

2. Coeur d'Alene National Forest.

On the Coeur d'Alene National Forest an ideal site, consisting of heavy concentrations of R. inerme with an overstory of willow, was selected for a bulldozing operation.

In five hours a one-acre plot was cleared and all brush placed in position for burning. Duff and litter were incorporated with the mineral soil. The cost based on figures covering rental charge and cost of operation of the tractor amounted to $21.75 for the acre worked.

C. Grass Seeding Over Cleared Areas

1. Purpose

The purpose of grass seedings was to establish a sod and prevent the recurrence of Ribes and brush and eliminate the necessity of future Ribes eradication.

2. Methods and Grasses Used.

In the spring and late summer of each successive year following clearing and burning, grass seed was sown. The schedule followed in seeding varied. In some cases pure but small stands of Kentucky bluegrass, common brome, timothy, and reed canary, redtop and meadow fescue were formed. The rule was, however, to sow a mixture of seed with sod-forming grasses always present in any mixture.

The following is the common schedule used showing the mixture and rate of seeding per acre on well drained soils.

Pasture Mixture	Rate of Seeding (Pounds per Acre)
Kentucky bluegrass	4 to 6
Orchard grass	4 to 6
Alsike clover	2 to 4
Timothy	2 to 4
Total	12 to 20

In moist and wet locations, either redtop or meadow fescue was sown at a rate of 12 pounds of meadow fescue per acre, and 15 pounds of redtop per acre.

Due to the presence of natural grasses along the stream bottoms it was always possible to make the mixture of seed cover a greater area than was originally planned. The presence of heavy duff also cut down on the rate of seeding per acre. Duff is a poor germination medium.

A cyclone hand seeder was used at times where areas to be planted exceeded two or more acres in extent, but due to the patchiness and presence of natural grasses, hand sowing seems to be more economical.

The following seeds were sown in the vicinity of Savenac Nursery during 1930 and 1931:

Species	Amount
Redtop grass	100 pounds
Kentucky bluegrass	75 pounds
Timothy	150 pounds
Alsike clover	100 pounds
Orchard grass	100 pounds
Meadow fescue	50 pounds
Red clover	50 pounds
Common brome grass	25 pounds
Slender wheat	25 pounds
Reed Canary grass	20 pounds
Total	695 pounds

3. Results

No attempt has ever been made to measure the exact acreage of grass formed as a result of artificial seeding. A sod has been formed on all areas previously occupied by piled brush. Fair to good stands of grass have been formed on all areas which had been sprayed and burned, and also on hand-cleared areas. Man or beast can now penetrate with ease approximately 95% of the 612.4 acres originally classed as stream type, brush and field sites. Grasses are present over the entire area. A clearing and burning program has enabled natural grasses to play an important part in permanent brush suppression. Artificial seeding has been the means of rapidly converting dense R. inerme areas into permanent grazing sites.

D. Ribes Reeradication

Following are results of Ribes reeradication performed over cleared and burned areas during the season of 1931.

TABLE NO. 3

RESULTS OF RIBES REERADICATION, SAVENAC NURSERY

Drainage	Acreage	Total Ribes Removed									Total Man Days
		R. inerme			R. petiolare			Total			
		Seedlings	Sprouts	Mature Bush	Seedlings	Sprouts	Mature Bush	Seedlings	Sprouts	Mature Bush	
St. Regis River	240	277	129	3	-	-	-	277	129	3	2
Savenac Creek	31	78	45	1	96	35	-	174	80	1	1½
Big Creek	38	412	138	16	-	8	4	412	146	20	1½
Totals	309	767	312	20	96	43	4	863	335	24	4¾

1. Results of Other Experiments in Reeradication

In a boggy swamp at the mouth of Big Creek, numerous R. inerme and R. petiolare seedlings germinated after the 1930 burn. A five per cent solution of $NaClO_3$ applied in July 1931 seemed to prove very effective in killing the tender seedlings.

On lower Savenac Creek there was a similar occurrence of R. inerme

and R. petiolare seedlings. Here the seedlings and duff were sprayed with crank case oil and immediately ignited with a Hauch torch. The flames spread rapidly and a good duff burn was secured. This method likewise proved very effective.

During the early fall a man equipped with a Hauck torch covered the stream bottoms where clearing had previously been done and set fire to logs and stumps. This method resulted in the destruction of innumerable Ribes seed, since the fire often spreads over a considerable distance from the logs.

COSTS

The following table shows the total cost of the operations:

TABLE NO. 4

STATEMENT OF COST OF OPERATION
SAVENAC NURSERY AND COEUR D'ALENE NATIONAL FOREST

Item of Expenditure	Cost
Salaries	$2,472.00
Subsistence	201.80
Transportation and Cost of Chemicals	159.92
Cost of Caterpillar Operation	51.40
Transportation and Cost of Oil for Burning	11.00
Seed	129.75
Miscellaneous	25.00
Total	$3,050.87

$1,880.62 paid from Forest Service allotment.

CONCLUSIONS

Various methods of preparing areas for burning have been tried. Preparing an area and burning that area are two different problems. Unless the necessary precautions, such as proper trenching and creating fire breaks are taken, the chance to burn at a most opportune time may be lost. This is particularly true where preparations are made by hand. The use of machinery lessens the great hazard involved in burning because a good trench is always present. The speculation as to time of burning is removed. It is not necessary to have dry weather and a favorable wind to burn piled brush. Machinery will perform every phase of brush work more efficiently and more economically than it can be done by hand methods.

With properly designed machinery the way is clear to go ahead and



W893
One year old stand of timothy and clover on light burned area.
On this plot over 3,000 Ribes seedlings were suppressed and replaced.



Reed Canary grass replacing Ribes on a burned site.

eradicate Ribes on a large scale. A combination consisting of a moderately powered bulldozer-equipped Caterpillar tractor, and perhaps a knapsack spraying unit which can be shifted to other operations undoubtedly will work well. There is room for a small 10 to 20 horsepower Caterpillar to work light concentrations of brush. For the present, however, a team of horses, a plow and a harrow will work well.

Along stream bottoms there occurs an abundance of natural grasses, good soil and plenty of moisture. These natural grasses will assist man's effort in permanently suppressing Ribes in the stream type.

EXPERIMENTS WITH THE VIEW OF TESTING NEW GRASSES AND DETERMINING THE PROPER TIME OF SEEDING

Mr. L. W. Kephart, Senior Agronomist, Division of Forage Crops, visited the Savenac Nursery Ribes eradication area. Mr. Kephart submitted a plan which called for the planting of 21 different forage plants which are as follows: Reed Canary grass, Holcus lanatus, Smooth brome grass, Kentucky bluegrass, Canada bluegrass, Redtop, Timothy, Orchard grass, English perennial rye grass, Astoria bent grass, Chewing's fescue, Meadow fescue, Festuca Idahoensis, Tall meadow oat grass, Meadow foxtail, Yellow sweet clover, White clover, Alsike clover, Red clover and Alfalfa.

Mr. J. H. Christ of the University of Idaho Field Station assisted and supervised the work. Mr. Christ's report follows:

FALL 1931 GRASS SEEDING AT HAUGAN, MONTANA

by

J. H. Christ, Superintendent
University of Idaho Field Station

Fall seeding of grasses was done at Haugan, Montana on September 17 and 18, 1931. Four areas were laid out for fall plantings. Three of these were platted on the St. Regis River, one on a cleared area which had been cropped the current year to oats, another on a 1931 summer burn, and a third on an area where the brush had been slashed and piled and then burned, followed by stirring up a seed bed by men with grub hoes. A fourth planting was made on Dry Creek where clearing had been accomplished by a bulldozer. A few additional seedings were made on Big Creek on an old burn. Due to the heavy establishment of weeds and grass, no seedings were made on Savenac Creek on 1930 burn areas. The size of the plats varied at the different locations as it was necessary to accommodate the plats to the amount of land available. The full series of twenty-one grasses and legumes was seeded at each of the four locations, and on three of them provision was made for spring plantings.

Seeding in all cases was done according to the schedule of planting suggested by Mr. L. W. Kephart. With a reduction in size of plats on some of the sets the amount of seed used was reduced proportionately. None of the clovers or alfalfa were inoculated. This should be provided on any future seedings of alfalfa or sweet clover. It will be necessary to have about 10 pounds of meadow fescue, 10 pounds of tall meadow oat and 10 pound of meadow foxtail for the spring plantings.

A. Grass Seeding on Oat Field, St. Regis River

The total area of the oat field was about two acres and plats were laid out quite uniformly except for a small dry gully which extended through the center of the range and cuts out on the last plat of the fall series. The land which had been cleared in 1930 contained a heavy stand of R. inerme. It was seeded to oats in the spring of 1931 and this crop was removed in August, 1931. It was the first crop after clearing. The land was prepared for grass seedings by going over the oat stubble with a spring-tooth harrow, September 16, 1931. This loosened the soil slightly and made a good seed bed. The soil is a gray silty sand, with gravel mixture. Stream outwash boulders extend into the plat area on the north-east corner. Soil is typical of high-water table land, but now that it is cleared the surface and subsurface drainage is good and there will probably be a definite drought effect on plantings by midseason. Moisture content at time of seeding was good owing to heavy early September rain.

Seed was broadcast by hand and not covered. Rate of seeding followed Kephart schedule, order of planting was the same and was numbered from southwest corner. The south half of staked area was seeded September 17, 1931. A slight amount of Canada and Kentucky bluegrass was present.

B. St. Regis Summer 1931 Burn

The area on the St. Regis bottom burned in August, 1931. This was a hot fire over practically all of the plat set. In a few spots the duff had not been thoroughly burned but sufficient land was available for seeding each grass variety. This was wet thoroughly by early September rains prior to seeding. Small swales and beaver ditches are found in the staked area. Soil is a gray silt showing effect of high-water table. The water is held high and the area should be moist throughout the year. The soil is high in organic matter. The plats are onerod by two rods, making the plats one-eightieth of an acre. Sufficient land was available for the laying out of 21 plats for September seedings. Burning is to be done during September so that a similar area will be available for spring planting. Fall seeding was made September 17, 1931 according to Kephart schedule but at a rate proportional to size of area seeded.

C. St. Regis Grubbed-Over Area

The seeding on the grubbed-over area was made September 17, 1931.

This brush was slashed and piled in May, 1931. About half of the piles were burned on April 24, 1931 and the balance on September 15, 1931. The land was then reworked and the soil worked up by men with grub hoes. The ashes from the September burn had not been dampened by rain prior to seeding and in a few spots were still hot.

The soil is a gray silty sand intermixed with gravel and boulders. The subsoil is a river gravel wash. The area borders a high water channel of the St. Regis River.

Plants present in varying amounts are the following: Nettle, Canada and Kentucky bluegrass, Geum strictum, Pentstemon confertus, raspberry, willow, mullein, Aster sp., Lonicera involucrata, Cirsium lanceolata, Agrostis sp., Rudbeckia sp., timothy, dandelion, Carex sp., Solidago missouriensis, Mentha canadensis and others.

The plats are one rod by two, numbered from the southeast corner and were seeded according to Kephart schedule in proportion to size of area.

D. Grass Seeding on Dry Creek

The Dry Creek area was cleared in August, 1931, with bulldozer. The roots, stumps and debris were pushed to the south side of the gulch. About half of the plat area was picked of loose sticks and roots prior to seeding, the balance is to be cleared up later. Soil is a black loam in the gulch bottom, grading into a red mineral soil on both edges. The center line of plats was laid out in the center of the gulch. Fall seeding was done on the south half and numbered from the southwest corner. Plats are 8-1/4 feet by 16-1/2 feet, making 1/320 of an acre. The rate of seeding was 1/8 of Kephart's schedule, to conform with the plat area. Seedings were made on September 17, 1931. Plats are numbered from the west corner.

SCOUTING FOR BLISTER RUST, MONTANA, 1931

By
C. H. Johnson,
Associate Pathologist

Scouting in northwestern Montana was carried on during the latter part of the 1931 field season in accordance with the general scouting plan for the entire region. The bulk of the work was performed during the season from July to October, with the assistance of several members of the Spokane office. The most intensive work was confined to the region where the rust was found in 1929 and 1930.

In general, scouting on both pines and Ribes was performed in three regions of western Montana. These were:

1. The drainage of the St. Regis River and its tributaries from St. Regis, Montana west to the Idaho state boundary.

2. The drainage of the Missoula River and the Deer Creek and Blackfoot tributaries of that river.

3. The Flathead Lake region principally along the Swan and Flathead rivers.

No evidence of infection was found on either Ribes or pine during the course of this work.

The scouting program, briefly described above, constitutes work in those parts of western Montana where scouting has been done in previous years, with the exception of the Kootenai district in the extreme northwestern portion of the state, and the Glacier Park region near the Canadian boundary, and along the Continental Divide. In view of the fact that scouting was not performed in these two general localities last season, particular attention should be paid to them in 1932.

BLISTER RUST CONTROL WORK IN IDAHO
1931

Blister rust control activities in Idaho were continued as a cooperative project between the Bureau of Plant Industry and the Idaho State Department of Agriculture, the Idaho State Land Board, the Idaho State Board of Forestry, the University of Idaho, the Clearwater Timber Protective Association, the Potlatch Timber Protective Association, the Coeur d'Alene Timber Protective Association, the Pend Oreille Timber Protective Association, and the Priest Lake Timber Protective Association.

In order to better express the cooperative relations existing upon the Idaho work, a general memorandum of understanding was prepared and signed by representatives of the above agencies, this memorandum going into effect upon July 1, 1931. This new memorandum is general in nature and does not directly express any financial cooperation, merely stating that financial cooperation will be the subject of special memorandums between the agencies concerned. Financial memorandums were drawn up between the Bureau of Plant Industry upon one hand and the State Land Board of Idaho, the University of Idaho, the Clearwater Timber Protective Association, the Potlatch Timber Protective Association, and the local group of land owners contributing to the Clarkia operation. These several memorandums follow the general memorandum.

MEMORANDUM OF UNDERSTANDING
between
THE BUREAU OF PLANT INDUSTRY, UNITED STATES DEPARTMENT OF AGRICULTURE
and the
DEPARTMENT OF AGRICULTURE, STATE OF IDAHO --- THE STATE LAND BOARD, STATE OF IDAHO - - STATE BOARD OF FORESTRY, STATE OF IDAHO - - UNIVERSITY OF IDAHO - - CLEARWATER TIMBER PROTECTIVE ASSOCIATION - - POTLATCH TIMBER PROTECTIVE ASSOCIATION - - COEUR D'ALENE TIMBER PROTECTIVE ASSOCIATION - - PEND OREILLE TIMBER PROTECTIVE ASSOCIATION - - PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION

Effective July 1, 1931

For the purpose of effectively controlling the white pine blister rust in Idaho, the several agencies shall cooperate in the following manner:

A. THE BUREAU OF PLANT INDUSTRY Agrees to:

1. Assume direct leadership in blister rust control operations in the State of Idaho.

2. In cooperation with the other agencies, develop methods of blister rust control suitable to forest conditions in Idaho.

3. Systematically scout to determine the presence of the disease in the State.

4. Provide necessary technical information regarding the disease and methods of its control to the other agencies.

B. THE STATE DEPARTMENT OF AGRICULTURE, STATE OF IDAHO, Agrees to:

1. Instruct its employees, in so far as their other duties will permit to:

a. Locate and systematically eradicate any cultivated black currants (Ribes nigrum) found within the State.

b. Scout for white pine blister rust.

c. Inspect nurseries in the State growing currants, gooseberries or white pines, for the presence of the rust.

C. THE STATE LAND BOARD, STATE OF IDAHO Agrees to:

1. Instruct its employees, in so far as their other duties will permit to scout for white pine blister rust and locate infected host plants.

2. Provide funds, when available for that purpose, for the control of white pine blister rust upon State white pine lands.

3. Cooperate in every practical way in promoting and assisting the various blister rust control activities carried on in the State.

D. THE STATE BOARD OF FORESTRY, STATE OF IDAHO Agrees to:

1. Cooperate through its deputized agents, in so far as their other duties permit, in scouting for white pine blister rust and locating infected host plants.

2. Cooperate in every practical manner in promoting and assisting the various blister rust control activities carried on in the State.

E. THE CLEARWATER TIMBER PROTECTIVE ASSOCIATION Agrees to:

1. Contribute the services of its employees, in so far as their other duties will permit, in:

a. Systematically locating cultivated black currants.

b. Scouting for white pine blister rust on the forest lands of the Association.

2. Cooperate with the Bureau of Plant Industry in every practicable manner to secure the control of white pine blister rust on the forest lands of the Association.

3. Supply the proper qualified employees of the Bureau of Plant Industry with such information regarding the condition of these forest lands as is necessary for the proper prosecution of the control operations.

F. THE POTLATCH TIMBER PROTECTIVE ASSOCIATION Agrees to:

1. Contribute the services of its employees, in so far as their other duties will permit, in:

a. Systematically locating cultivated black currants.

b. Scouting for white pine blister rust on the forest lands of the Association.

2. Cooperate with the Bureau of Plant Industry in every practicable manner to secure the control of white pine blister rust on the forest lands of the Association.

3. Supply the proper qualifed employees of the Bureau of Plant Industry with such information regarding the condition of these forest lands as is necessary for the proper prosecution of the control operations.

G. THE COEUR D'ALENE TIMBER PROTECTIVE ASSOCIATION Agrees to:

1. Contribute the services of its employees, in so far as their other duties will permit, in:

a. Systematically locating cultivated black currants.

b. Scouting for white pine blister rust on the forest lands of the Association.

2. Cooperate with the Bureau of Plant Industry in every practicable manner to secure the control of white pine blister rust on the forest lands of the Association.

3. Supply the proper qualified employees of the Bureau of Plant Industry with such information regarding the condition of the forest lands as is necessary for the proper prosecution of the control operations.

H. THE PEND OREILLE TIMBER PROTECTIVE ASSOCIATION Agrees to:

1. Contribute the services of its employees, in so far as their other duties will permit, in:

a. Systematically locating cultivated black currants.

b. Scouting for white pine blister rust on the forest lands of the Association.

2. Cooperate with the Bureau of Plant Industry in every practicable manner to secure the control of white pine blister rust on the forest lands of the Association.

3. Supply the proper qualified employees of the Bureau of Plant Industry with such information regarding the condition of these forest lands as is necessary for the proper prosecution of the control operations.

I. THE PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION Agrees to:

1. Contribute the services of its employees, in so far as their other duties will permit, in:

a. Systematically locating cultivated black currants.

b. Scouting for white pine blister rust on the forest lands of the Association.

2. Cooperate with the Bureau of Plant Industry in every practicable manner to secure the control of white pine blister rust on the forest lands of the Association.

3. Supply the proper qualified employees of the Bureau of Plant Industry with such information regarding the condition of these forest lands as is necessary for the proper prosecution of the control operations.

J. IT IS MUTUALLY AGREED That:

1. This memorandum shall be effective July 1, 1931 and shall remain in effect until terminated by any one of the parties hereto by written notice, or until amended by written mutual agreement.

2. The cooperative plan of work in this memorandum will be followed as being the best method of control of white pine blister rust in Idaho.

3. All official records and reports of work performed under this

agreement shall be open to inspection by any or all parties to this agreement, that all findings of blister rust made by any party to this agreement shall be reported promptly to all other parties to this agreement, and that all specimens collected by any party to this agreement which are suspected of being infected with blister rust shall be submitted promptly to the Bureau of Plant Industry for final determination.

4. The results of the cooperative work may be published jointly, or upon mutual agreement, by one of the cooperating parties, due credit being given to the cooperating agencies. All manuscripts therefore shall be criticized by the cooperating parties before publication; and all form letters, bulletins and any other circulars to be mailed in penalty envelopes shall be submitted in manuscript form for approval by the Bureau of Plant Industry before being printed or distributed.

5. Obligations by the Bureau of Plant Industry are contingent upon appropriations being made therefor by Congress, and no funds of the United States shall be expended in compensation for host plants destroyed in control work.

6. Appropriations or allotments for blister rust control operations shall be contingent upon availability of funds therefor.

7. Cooperative control activities between any two or more of these agencies, involving the expenditure of funds, shall be the subject of special agreement between the agencies conerned.

Date: Signature:

_____ (s) F. Lee Johnson
Department of Agriculture, State of Idaho

_____ (s) C. Ben Ross
State Land Board, State of Idaho

_____ (s) Ben E. Bush, Secy.
State Board of Forestry, State of Idaho

_____ (s) Ernest E. Hubert
University of Idaho

Date: Signature:

(s) C. L. Billings
Clearwater Timber Protective Association

(s) R. E. Irwin
Potlatch Timber Protective Association

(s) C. O. Graue, Secty-Treas.
Coeur d'Alene Timber Protective Association

(s) Ben E. Bush, Vice President
Pend Oreille Timber Protective Association

(s) J. S. Barron
Priest Lake Timber Protective Association

March 28, 1932 (s) K. F. Kellerman
Acting Chief, Bureau of Plant Industry, U.S.D.A.
JFM

MEMORANDUM OF UNDERSTANDING
between
THE BUREAU OF PLANT INDUSTRY, UNITED STATES DEPARTMENT OF AGRICULTURE
and the
STATE LAND DEPARTMENT, STATE OF IDAHO
Relative to
Cooperative White Pine Blister Rust Control

Effective April 1, 1931.

A. The purpose of cooperative work performed under terms of this agreement shall be to secure the control of white pine blister rust upon the areas as specified below.

B. THE BUREAU OF PLANT INDUSTRY agrees to:

1. Conduct the blister rust control operations herein described in accordance with the best known methods for such work.

2. Prepare and present to the cooperating agency a plan of the work and estimate of costs.

3. Prepare and present to the cooperating agency at suitable periods reports upon the progress of the work, and upon the disbursement of cooperative funds.

4. Disburse the cooperative funds placed at its disposal for this work in accordance with the Fiscal Regulations of the United States Department of Agriculture.

5. Contribute approximately $10,000.00 to this cooperative project for the period April 1, 1931 to March 31, 1932.

C. THE STATE LAND DEPARTMENT, STATE OF IDAHO agrees to:

1. Contribute approximately $5,000.00 to this cooperative project for the period April 1, 1931 to March 31, 1932. This contribution to be paid into the Treasury of the United States, in such installments and at such times as the Bureau of Plant Industry considers necessary for the proper prosecution of the work, and to be disbursed by the properly authorized officials of the Bureau of Plant Industry.

D. For the period stated above, this cooperative control work shall be performed in the North Fork of East River and its tributaries, lying within T. 59 N., R. 3 W., and T. 59 N., R. 2 W., Boise Meridian, Idaho. Location

of future work and amounts of future contributions can be stipulated by amendments to this agreement to be effective after March 1, 1932.

Date:	Signature:
June 23, 1931	(s) Ben E. Bush State Land Department, State of Idaho
	(s) W. A. Taylor Chief, Bureau of Plant Industry, U.S.D.A.

MEMORANDUM OF UNDERSTANDING
between
THE BUREAU OF PLANT INDUSTRY, UNITED STATES DEPARTMENT OF AGRICULTURE
and the
UNIVERSITY OF IDAHO
Relative to
Cooperative White Pine Blister Rust Control

Effective April 1, 1931

A. The purpose of cooperative work performed under terms of this agreement shall be to:

1. Secure the control of white pine blister rust in the white pine forests of Idaho.

2. Cooperate in the performance of experimental and investigative work designed to develop suitable methods of blister rust control.

B. THE BUREAU OF PLANT INDUSTRY agrees to:

1. Pay the salary and expenses, in accordance with the Fiscal Regulations of the United States Department of Agriculture, of one or more men to perform experimental and investigative work upon problems pertaining to blister rust control.

2. Contribute approximately $25,000 to the development of methods of blister rust control suitable to forest conditions in north Idaho.

C. THE UNIVERSITY OF IDAHO agrees to:

1. Provide office, laboratory and greenhouse facilities, through the School of Forestry, for employees of the Bureau of Plant Industry stationed at Moscow to conduct technical experiments and investigations as stipulated above.

2. Detail one member of the staff of the School of Forestry to this work for the major portion of the field season and to permit him sufficient time during the balance of the period of the agreement to generally assist in this work.

3. Make such studies, so far as the other duties of the staff of the School of Forestry will permit, as are considered necessary and advisable on the rate of growth of western white pine remaining on areas after logging and the expected yield of second growth white pine stands.

4. Assist the Bureau of Plant Industry, through the University Extension Service, so far as practicable in the educational activities

necessary to the effective conduct of the work.

5. Expend approximately $4,000 upon this cooperative project for the period April 1, 1931 to March 31, 1932.

D. IT IS MUTUALLY AGREED that:

1. All official records and reports of work performed under this agreement shall be open to inspection by any or all parties to this agreement, that all findings of blister rust made by any party to this agreement shall be promptly reported to all other parties to this agreement, and that all specimens collected by any party to this agreement which are suspected of being infected with blister rust shall be submitted promptly to the Bureau of Plant Industry for final determination.

2. The results of the cooperative work may be published jointly, or upon mutual agreement by either cooperating party, due credit being given to the cooperating agencies. All manuscripts therefore shall be criticised by the cooperating parties before publication; and all form letters, bulletins and any other circulars to be mailed in penalty envelopes shall be submitted in manuscript form for approval by the Bureau of Plant Industry before being printed or distributed.

3. This memorandum will remain in force for the period stated above except that it may be terminated at any time by one of the parties by written notice and may be amended by written mutual agreement.

Date:	Signature:
Oct. 29, 1931	F. G. Miller University of Idaho
Nov. 30, 1931	Wm. A. Taylor Chief, Bureau of Plant Industry, U. S. D. A.

MEMORANDUM OF UNDERSTANDING
between
THE BUREAU OF PLANT INDUSTRY, UNITED STATES DEPARTMENT OF AGRICULTURE
and the
CLEARWATER TIMBER PROTECTIVE ASSOCIATION
Relative to
Cooperative White Pine Blister Rust Control

Effective April 1, 1931

A. The purpose of cooperative work performed under terms of this agreement shall be to secure the control of white pine blister rust within the boundaries of the Clearwater Timber Protective Association.

B. THE BUREAU OF PLANT INDUSTRY agrees to:

1. Conduct the blister rust control operations herein described in accordance with the best known methods for such work.

2. Prepare and present to the cooperating agency a plan of the work and estimate of costs.

3. Prepare and present to the cooperating agency at suitable periods reports upon the progress of the work, and upon the disbursement of cooperative funds.

4. Disburse the cooperative funds placed at its disposal for this work in accordance with the Fiscal Regulations of the United States Department of Agriculture.

5. Contribute approximately $40,000.00 to this cooperative project for the period April 1, 1931 to March 31, 1932.

C. THE CLEARWATER TIMBER PROTECTIVE ASSOCIATION agrees to:

1. Contribute approximately $20,000.00 to this cooperative project for the period of April 1, 1931 to March 31, 1932. This contribution to be paid into the Treasury of the United States, in such installments and at such times as the Bureau of Plant Industry considers necessary for the proper prosecution of the work and to be disbursed by the properly authorized officials of the Bureau of Plant Industry.

2. To give every reasonable assistance to the proper prosecution of the blister rust control work within the boundaries of the Association.

D. For the period stated above this cooperative control work shall be carried on in Working units 2, 3, 4, 6, 8, 9, 10 and 12. Location of future work

and amounts of future contributions can be stipulated by amendment to this agreement, to be effective after March 31, 1932.

Date:	Signature:
June 27, 1931	(s) Theo. Fohl, Secretary-Treasurer Clearwater Timber Protective Association
July 14, 1931	(s) W. A. Taylor Chief, Bureau of Plant Industry, U. S. D. A

MEMORANDUM OF UNDERSTANDING
between
THE BUREAU OF PLANT INDUSTRY, UNITED STATES DEPARTMENT OF AGRICULTURE
and the
POTLATCH TIMBER PROTECTIVE ASSOCIATION
Relative to
Cooperative White Pine Blister Rust Control

Effective April 1, 1931.

A. The purpose of cooperative work performed under terms of this agreement shall be to secure the control of white pine blister rust within the boundaries of the Potlatch Timber Protective Association.

B. THE BUREAU OF PLANT INDUSTRY agrees to:

1. Conduct the blister rust control operations herein described in accordance with the best known methods for such work.

2. Prepare and present to the cooperating agency a plan of the work and estimate of costs.

3. Prepare and present to the cooperating agency at suitable periods reports upon the progress of the work, and upon the disbursement of cooperative funds.

4. Disburse the cooperative funds placed at its disposal for this work in accordance with the Fiscal Regulations of the United States Department of Agriculture.

5. Contribute approximately $20,000.00 to this cooperative project for the period April 1, 1931 to March 31, 1932.

C. THE POTLATCH TIMBER PROTECTIVE ASSOCIATION agrees to:

1. Contribute approximately $10,000.00 to this cooperative project for the period of April 1, 1931 to March 31, 1932. This contribution to be paid into the Treasury of the United States, in such installments and at such times as the Bureau of Plant Industry considers necessary for the proper prosecution of the work and to be disbursed by the properly authorized officials of the Bureau of Plant Industry.

2. To give every reasonable assistance to the proper prosecution of the blister rust control work within the boundaries of the Association.

D. For the period stated above this cooperative control work shall be carried on in Working Units 3, 4, 7, 12, 17, 18 and 22. Location of future work and amounts of future contributions can be stipulated by amendment to this agreement, to be effective after March 31, 1932.

Date:	Signature:
June 30, 1931	(s) W. D. Humiston Potlatch Timber Protective Association
	(s) W. A. Taylor Chief, Bureau of Plant Industry, U. S. D. A.

MEMORANDUM OF UNDERSTANDING
between
THE BUREAU OF PLANT INDUSTRY, UNITED STATES DEPARTMENT OF AGRICULTURE
and the
POTLATCH FORESTS, INC. - - MILWAUKEE LAND CO. - - STATE LAND DEPARTMENT, STATE OF IDAHO
Relative to
Cooperative White Pine Blister Rust Control

Effective April 1, 1931.

A. The purpose of cooperative work performed under terms of this agreement shall be to secure the control of white pine blister rust upon the areas as specified below.

B. THE BUREAU OF PLANT INDUSTRY agrees to:

1. Conduct the blister rust control operations herein described in accordance with the best known methods for such work.

2. Prepare and present to the cooperating agencies a plan of the work and estimate of costs.

3. Prepare and present to the cooperating agencies at suitable periods reports upon the progress of the work, and upon the disbursement of cooperative funds.

4. Disburse the cooperative funds placed at its disposal for this work in accordance with the Fiscal Regulations of the United States Department of Agriculture.

5. Contribute approximately $12,000.00 to this cooperative project for the period April 1, 1931 to March 31, 1932.

C. POTLATCH FORESTS, INC. agrees to:

1. Contribute approximately $2,500.00 to this cooperative project for the period April 1, 1931 to March 31, 1932. This contribution to be paid into the Treasury of the United States, in such installments and at such times as the Bureau of Plant Industry considers necessary for the proper prosecution of the work, and to be disbursed by the properly authorized officials of the Bureau of Plant Industry.

D. The MILWAUKEE LAND CO. agrees to:

1. Contribute approximately $2,500.00 to this cooperative project for

the period of April 1, 1931 to March 31, 1932. This contribution to be paid into the Treasury of the United States, in such installments and at such times as the Bureau of Plant Industry considers necessary for the proper prosecution of the work, and to be disbursed by the properly authorized officials of the Bureau of Plant Industry.

E. THE STATE LAND DEPARTMENT OF THE STATE OF IDAHO agrees to:

1. Contribute approximately $1,000.00 to this cooperative project for the period April 1, 1931 to March 31, 1932. This contribution to be paid into the Treasury of the United States, in such installments and at such times as the Bureau of Plant Industry considers necessary for the proper prosecution of the work, and to be disbursed by the properly authorized officials of the Bureau of Plant Industry.

F. For the period stated above, this cooperative control work shall be performed in T. 42 N., R. 2 E., Boise Meridian, Idaho. Location of future work and amounts of future contributions can be stipulated by amendments to this agreement, to be effective after March 31, 1932.

Date	Signature
	POTLATCH FORESTS, INC.
June 12, 1931	(s) By G. F. Jewett
	POTLATCH FORESTS, INC.
June 16, 1931	(s) by C. B. Sanderson
	MILWAUKEE LAND COMPANY
June 23, 1931	(s) Ben B. Bush
	STATE LAND DEPARTMENT, STATE OF IDAHO
	(s) Wm. A. Taylor
	BUREAU OF PLANT INDUSTRY, U. S. D. A.

RIBES ECOLOGY IN THE INLAND EMPIRE, 1931

By
C. W. Waters
Agent

INTRODUCTION

A careful survey of the results thus far obtained through investigations and studies of Ribes ecology brings to light the fact that there remain many questions yet unanswered concerning the life habits of the several species of Ribes found within the white pine region of the Inland Empire. As the control program moves forward it becomes increasingly more evident that such questions must be answered in order that the progress of such a program will not be impeded. Toward such an end the future studies of the Ribes ecology work must be planned.

During the season of 1931 no extensive new studies were developed, the aim being to concentrate on a few unsolved problems with the hope that upon their solution can be built future plans of action.

Four studies were in progress during the season of 1931; only one of which was new. They were as follows:

A. Controlled Plot studies.
B. Seed Storage Studies.
C. Study of the Effects of Cutting Methods on Ribes Seed Germination and Seedling Survival.
D. Ribes Seed Germination Studies.

The methods and results of these will be discussed separately in the above order.

A. CONTROLLED PLOT STUDIES

Purpose

The purpose of this study is outlined in the 1928 annual report, pages 27 and 28, and although the original intention was to abandon such studies at the close of the third year, it seemed advisable to continue them indefinitely on a much less extensive scale. The present plan is to continue examinations of such plots twice during each season and make observations on the survival, rate of growth and time of fruiting of the Ribes therein. In this manner valuable information can be obtained as to the life habits of Ribes viscosissimum and such data become the more desirable since the exact time of germination is known for each plant as well as the environmental conditions under which the individual plants germinated and

developed.

Methods

Described on pages 131-134 of the 1927 annual report and page 28 of the 1928 report, except that beginning with 1930, the group of plots designated as Series 3 were no longer covered with the muslin covering. In brief, the entire three series of plots are uncovered at all times.

During the season of 1931 two observations were made on the plots, the one extending from June 24 to July 6, the other from September 25 to November 16. During the fall reading of 1930 the heights of all Ribes plants were recorded.

Results

1. Of a total of 236 milacres established in 1927, only 4 new Ribes seedlings were found during the current season. Three of these were observed during the spring examination, and the remaining one at the time of the fall examination.

2. In the same number of milacres 194 deaths were found during the spring examination and 21 during the fall. Of these deaths practically 100 per cent were plants which had been listed as either of 1930 germination or those plants of previous years which had not attained a height of over .5 foot. Thus it appears that the death of Ribes on the plots during the current year occurred among those seedlings which were very small, irrespective of age. Conversely, it may be said that those Ribes plants which have succeeded in reaching a foot or more in height appear to be firmly established and may be expected to reach successfully the fruiting stage. Of these numbers, of course, some will be killed by grazing and tramping of animals.

3. Twelve bushes of R. viscosissimum were found fruiting on the plots. These bushes were of 1927 germination and were all located on the Camp D area distributed over four different milacres and, strangely enough, every one was on the milacres which had had all duff removed.

B. SEED STORAGE STUDY

This study is a continuation of the seed storage study begun in 1930, and has for its object an attempt to determine the presence or absence of, and if present, the exact location of viable Ribes seeds in the organic mantle in the white pine stands of northern Idaho. The results of the controlled plot studies have demonstrated beyond doubt that, following any major disturbance of the forest carpet or of the forest canopy due to such causes as fire, logging, etc., numbers of Ribes seedlings

make their appearance. Studies have shown further that such Ribes seeds have apparently lain dormant for periods of several years beneath the duff mantle of most parts of the white pine region of northern Idaho. These seeds seem to be quite as generally distributed in the Ribes-free areas of the region as where fruiting Ribes plants are now present. The studies have further seemed to point to the probability that in the older stands the seeds are resting deeper in the mantle and are rather intimately associated with the mineral soil, whereas in the younger stands the seeds may occupy a relatively greater proportion of the organic mantle. As to the relation of the age of the stand to the number of viable Ribes seeds present in the forest carpet no information has as yet been obtained and it was to answer this question as well as several others that the present storage study was undertaken.

It was planned to take samples from as many age classes as possible with the number of samples from each age class being great enough to give a representative picture.

A total of 2,055 collections of organic mantle were made representing 685 distinct plots of ground. (This figure represents the actual number of samples collected, there being three layers taken from each spot). In very few cases have more than 20 squares been taken from any one site so that the samples are representative of a wide range of conditions. Samples were collected from five national forests, including the Kaniksu, St. Joe, Coeur d'Alene, Pend Oreille and Clearwater as well as from privately-owned land. In all cases the samples were taken as far distant as possible from any living Ribes bushes so that any seeds obtained would represent what may be termed as stored seeds, unless such seeds had been transported recently into the stands from great distances.

The following table shows the distribution of the samples among the various age classes:

TABLE NO. 1

SAMPLES OF ORGANIC MANTLE COLLECTED 1931

Age Class	21-40	41-60	61-80	81-100	101-160	161-200	200+	Total
Number of areas represented	21	8	7	10	14	18	6	84
Number of samples	190	60	70	75	145	90	55	685

The method of collecting the samples in the field was the same as used during the preliminary work of 1930 and is described on page 33 of

the 1930 annual report. The treatment accorded the samples after bringing them from the field was quite different, however, and was as follows: The samples were spread out on paper plates and allowed to dry. Each sample was then run through a "Clipper Seed Cleaner" whereby all of the larger and lighter bits of debris were discarded. This reduced the sample to about one ounce in volume. This residue consisted of all the smaller seeds approximately the size of Ribes seeds, together with a certain amount of mineral soil particles which could not be separated by the cleaner. This was placed in a 1-ounce homeopathic vial, moistened, but not saturated with water, tightly stoppered and taken to the blister rust laboratory at the University of Idaho where the entire lot was placed in a constant temperature chamber at 5° C. Here they remained until September when they were prepared for germination. The germination studies are being continued and will probably be concluded by the summer of 1932. The method of germinating the samples is as follows:

The samples were sifted and screened until a volume of from 5 to 25 cubic centimeters of particles similar in size to Ribes seeds were left from each original sample. A few drops of distilled water were added to each sample after it had been placed in a small vial. These vials were then set in a 5° C. chamber where they remained until planted.

There were too many samples to germinate at one time with the equipment available, but by crowding the chambers to full capacity it was possible to run one-half of them at the same time. There were 748 samples and 372 of them are being run in the first set. (This figure is in excess of the actual number of samples collected since some samples were too large to be contained in one vial.) The principle upon which they were divided was that each site class was divided into halves keeping the A, B, and C samples as even in number as possible. The A samples constitute litter, the B samples are duff, and the C samples are humus. This method made the two sets of samples as nearly identical as their nature would permit.

The samples were dipped in a weak sulphuric acid solution to stimulate germination. A special dipping pan was necessary to speed the dipping process and at the same time make it possible to remove the dipped sample without using more water than was needed for moistening the sand medium upon which the sample was germinated. The dipper which is constructed of sheet copper and soldered with a pure tin solder to avoid undesirable corrosive effects, is a short section of a cylinder 1.25 inches deep and 2.5 inches in diameter with the walls turned in to support a removable bottom of 40-mesh copper screen wire. The dipper is equipped with handle and cover to facilitate handling of the samples. Each sample was placed in the dipper and then immersed in a 4 per cent solution of sulphuric acid for

five minutes. The dipper was splashed about in the solution to insure a thorough soaking of the entire sample. At the end of the five minutes the sample was drained for a few seconds and after being washed with distilled water, was placed in a 0.2 per cent solution of potassium bicarbonate. It was allowed to remain there for about a minute when it was washed again with distilled water. This completed the dipping process.

The samples after being dipped were placed on sterilized sand which had been saturated with distilled water. The dishes were then stored in the 10° C. chamber until all the samples were planted. A period of 48 hours was allowed to elapse from the time the last sample was planted until the set was placed in the alternating temperature combination. This delay allowed the seeds to become thoroughly plumped before germination was attempted.

The 25° C. - 5° C. temperature combination was used because the seeds of the Ribes species which were expected to be present preferred this combination. The dishes are to remain in incubation for four months, giving them one month longer than is usually allowed for germination.

The seedlings were transplanted to specially prepared dishes as soon as they had germinated. Each sample in the chambers had a corresponding transplant dish. This was done to prevent the seedlings from losing their identity. The transplant dishes contained four grams of sterilized air-dried peat which had been neutralized with calcium carbonate. The seedlings were watered with distilled water and at intervals a few drops of 1/2 Hoagland nutrient solution were added. It was necessary to make a special transfer rack with trays to facilitate the handling of so many dishes. The peak of germination was reached during the second week of incubation and has gradually tapered down until only a few seedlings per day are germinating. A heavy mortality occurred among the seedlings following transplanting. This mortality was probably due to several factors. Many of the seedlings were of forest floor species which are very delicate and these would not stand the shock of being transplanted. Some of the seedlings were injured when transferred or during the period which followed. In one case too much nutrient solution was added thus taking a heavy toll. Damping off caused the most trouble during the first part of the run as there was little, if any, sunlight. Some sunlight is available nearly every day and this is augmented by a powerful electric light. Damping off under these conditions still causes some mortality but only a small fraction of its previous damage.

The surviving seedlings are grown until they are large enough to be identified. This can usually be done after the first or second pair of leaves appear. The growth of the Ribes seedlings is continued until they

are large enough to be identified by species. Some of these identified seedlings were pressed so as to have a permanent record or check, but the seedlings were too succulent and little remained after drying. They are now being put in a preservative solution and although this decolorizes them, they are still satisfactory for identification purposes.

A summary of the data taken during the first three months of the first set shows that 34 seedlings of R. viscosissimum were secured; of these, three were from the A layer of duff, 8 from the B layer and 23 seedlings from the C layer. Classifying the seedlings on the basis of the age class of the timber stand from which the samples were collected shows that 18 came from the 20 to 40-year-old stands, 9 from the 40 to 60, none from the 60 to 80, 3 from the 80 to 100, none from the 100 to 150, 3 from the 150 to 200, and one from stands over 200 years old. These data cannot be further analyzed until the number of samples from each age class and the history of each sample has been computed.

C. STUDY OF THE EFFECTS OF CUTTING METHODS ON RIBES SEED GERMINATION AND SEEDLING SURVIVAL

Purpose

This study was undertaken with the idea of making a study of the effects of cutting methods on the germination and survival of Ribes and conifer reproduction.

From the results of previous studies it has seemed evident that the upland types of Ribes, namely R. viscosissimum and R. lacustre, are most abundant in young reproductive stands, to a lesser degree in older poorly-stocked stands, and are practically absent in older stands which are well stocked. Thus it would appear that the degree of stocking of the stand had some effect upon the prevalence or paucity of Ribes plants growing therein. This suggests the possibility that R. viscosissimum and R. lacustre might be inhibited from inception and growth by controlling the density of such stands by cutting methods, and in such manner control the reproduction of the upland species of Ribes by silvicultural methods rather than by continuous Ribes eradication. If by accurate and intensive measurements made in the field during several seasons it could be shown that a certain combination of such factors as light, moisture, temperature, pH, etc., clearly inhibited the germination and growth of Ribes plants and at the same time did not react deleteriously to natural conifer reproduction, the results of such studies might possibly be applied on a practical basis to a silvicultural practice of cutting.

Such experimental results could be carefully substantiated by continued observations on areas where Ribes seeds were known to be present

and checked with germination tests conducted under laboratory conditions on Ribes seeds of similar species.

Such is the purpose of the following study.

Methods

This study was initiated during the season of 1931 on a preliminary basis in the following manner:

The study was laid out on average or representative areas in the cut-over stands for the 17" diameter limit cuttings located on the Clearwater Timber Company's holdings near Headquarters, Idaho. The plots totaled five in number and were distributed between two areas.

Plots No. 2 and No. 3 were established on the area known as the University of Idaho plots and Plots No. 1, 4 and 5 on the area known as the Brush Creek Area. On the former the timber was felled in 1928 and the brush burned during the following spring; the latter area was logged in 1930 and the brush burned during the early spring of 1931. Each plot was laid out in the form of a square, 52.8' on a side, thus making the area of each plot 64 milacres. The milacres were marked off by strings stretched across the plots at 6.6-ft. intervals and the individual milacres were carefully checked for any possible Ribes and conifer seedlings and each marked by a metal pin with a serial number. The plots were carefully mapped to scale showing the reproduction, species and D.B.H. of standing trees; location, diameter and species of tree stumps; and number and extent of brush pile burns, down and rotten logs. In addition full descriptive data concerning duff, mineral soil, ground cover, exposure, slope, etc., were recorded on forms designed for that purpose.

The plots were distributed over the area adjacent to Headquarters in such a manner that several of the varying conditions representative of this type of cutting were obtained. It is obviousthat, although constant diameter limits were held to in the logging procedure, great variations are bound to exist over the area, due to unequal grouping of trees, varying types of exposure and different degrees of slope. For this reason the distribution of the plots was necessary.

The following table illustrates the varying conditions under which the study plots were laid out:

TABLE NO. 2

DESCRIPTION OF PLOTS

Plot No.	Age Class	Exposure	Slope	Time of Cutting	Brush Burned	Percentage of Sky Opening
1	150	East and west	30%	Winter of 1930-31	Spring of 1931	36
2	100	East	Level	1928	1929	22
3	150	Top of ridge	Almost level	1928	1929	73
4	150	East and south	10%	1930-31	1931	44
5	150	Top of ridge	10%	1930-31	1931	16

After a thorough survey of the area in which the 17" diameter cutting method had been practiced, Plot 1 was chosen as being the average or most representative area in the cut-over stand. Plots 2 and 5 were selected as representing areas with the maximum amount of canopy remaining: Plot 3 to represent the opposite extreme, and Plot 4 was chosen for study because it was observed that numbers of R. petiolare had made their appearance following the logging operations and it was thought to be an excellent opportunity to study their development.

The following factors were measured during the season extending from the early part of July, 1932 until after the fall rains of November 10, 1932.

1. Temperature. Temperature records were made for four of the five plots. On Plot No. 1 a detailed record was kept by means of 7 thermocouples placed at diferent locations on the plot and in different types of disturbances. These readings on Plot 1 were made hourly during the day and once during the night. Maximum and minimum temperatures under burns were recorded for Plots No. 2, 4, and 5. No temperature record was kept for Plot 3 since this plot had 73 per cent sky opening and it was feared that the resulting high temperatures would exceed the capacity of the maximum thermometer.

2. Moisture. Moisture measurements were made on all five of the plots. These measurements were taken from six different locations on each plot representing the different types of disturbance thereupon. They were

taken at weekly intervals and two methods were employed. Wooden pegs (white pine) oven dried, were placed in the ground at the level of mineral soil and allowed to remain for four days. They were then weighed and the percentage of moisture computed. This method was checked by means of soil samples taken at the same time from the same locations. It is unfortunate that the moisture measurements were not begun until July 17, for this is beyond the period of most abundant Ribes seed germination as shown by the controlled plots.

3. pH Measurements. pH measurements were made at weekly intervals at the same six locations on the plots where the soil moisture determinations were made. At each of these points a section of the organic mantle, including part of the humus, was taken out. This was discarded and the remaining portion of humus and some of the mineral soil was saved for the pH determinations. Two methods of calculation were used, the colorimetric and the quinhydrone. It was found that the quinhydrone method gave approximately an average of two colorimetric readings so that a perfect check was made, one method against the other.

4. Light study. Light was the most difficult of the several environmental factors to measure. No satisfactory device has yet been perfected for calculating with accuracy the various light rays which reach a plant. It was finally decided to attempt only a qualitative and comparative measure of light by photographing the opening in the canopy above the plots.

Four light stations were established on each plot in such a manner that each station covered approximately one-fourth of the plot. Stationary platforms about three feet high were built in the center of each one-fourth plot. The top of the platform was leveled and a camera placed thereon with the lens pointing vertically. One exposure was made from each station so that by four exposures the entire canopy of each plot was photographed. This was done for each plot and the prints pieced together in a mosaic. Planimeter measurements were made and the open areas in the canopy of each plot expressed as a percentage of the total area of the canopy. This percentage is referred to as the sky opening. While this method is in no wise accurate and is subject to just criticism, it does offer a relative measurement of the amount of light that can fall upon the plots.

Results

It has already been stated that the results which would be possible to obtain through one season's work of this nature could be at the most only indicative. No sound conclusions could be drawn from such preliminary results and it remains for additional studies to be conducted before results

of a conclusive nature can be presented. The most glaring fault of this study is that no measurements were taken at the time when the various environmental factors are perhaps the most operative. Results from the Controlled Plot Studies have shown that the germination of Ribes seeds proceeds most actively during the early season and it is in this interval that no data were secured. However, certain interesting interrelations of factors have come to light which may prove to be of importance later.

1. Moisture. When average temperature was plotted against average moisture the curve showed a rapid drying out of the soil with an increase in temperature.

When duff and burns are compared, the results show that the former consistently retains a higher degree of moisture than the latter. That is, of course, subject to variations in degree of shade, exposure and slope. Other factors being equal, northern slopes naturally record higher moisture averages on both duff and burns than does duff on south or east exposures.

2. Temperature. In three of the four plots where maximum daily soil temperatures were recorded a direct relationship was shown between average maximum temperature and sky opening, the temperatures decreasing with smaller opening. This was much more pronounced on burns than in duff, the latter showing less variation. Day and night temperatures on Plot No. 1, taken September 10 at 15-minute intervals, showed on burns a temperature peak of 30.5° C. during the day, dropping to 2° C. during the night. In duff on the same plot the divergency was never more than 8° C. Air temperatures were found to be intermediate between those of duff and burns.

3. pH measurements. pH readings made in duff and on burns showed consistently a much higher reading on the latter. Average seasonal pH records on burns ranged from 6.5 to 7.45; in duff from 5.1 to 5.85. A peculiar relationship was shown between moisture content of the burns and pH; an increase in moisture on the burn was followed by a decrease in pH and vice versa. This was not the case in duff. From the limited data thus far obtained no correlation could be detected between the pH of the soil and conifer and Ribes reproduction. This is not peculiar since on three of the plots only a few months had elapsed since logging, and new seedlings of Ribes or conifers would not be likely to appear in appreciable numbers before the spring of 1932.

4. Light study. Although it was not possible to obtain a direct measurement of the total intensity of light or the quality of the light rays which fell upon the several plots, a correlation was obtained between the size of the sky openings and moisture and temperature. Moisture in turn influenced the pH so that it appears that light might be considered as the main limiting factor which governs the development of vegetation following a major disturbance, whether it be due to fire or logging operations.

Due to the preliminary nature of the study, no opportunity has yet arisen to follow through the influence of light, moisture, temperature and PH on the survival of either Ribes or conifer reproduction. This should be done by means of a series of plots laid out in this same region and followed through from March to November over a period of several years. Until such is done, any conclusions relative to the possibility of instituting a plan of cutting whereby Ribes will be inhibited from development can be only speculative.

D. RIBES SEED GERMINATION STUDIES

The remainder of this report was prepared by D. R. Miller, Junior Forester.

The Ribes seed germination study which is being conducted in the laboratory at Moscow, Idaho was continued during the fall of 1930 and the spring of 1931. During this time two general tests were made augmented with a few side experiments. The leads on best temperatures and pH concentrations secured from the tests made during the spring of 1930 were followed. In addition, high and low temperatures, as well as certain chemicals were tested as germination stimulants.

It has been observed in nature that germination is practically completed in from four to six weeks after it starts in the spring. Using this as a basis, each set of seeds was kept in the chambers for three months and then discarded regardless of whether or not germination was still occurring. This allowed about twice the time required in nature. In case complete germination had not occurred at the end of the three months, it was assumed that the germination requirements had been only partially fulfilled; and the set was discarded and another one started.

The six species of seeds used for most tests were R. inerme, R. lacustre, R. nevadense, R. petiolare, R. roezli and R. viscosissimum. Current year seeds were used for all species except R. inerme. It was necessary to use 1928 seeds of this species as no current year seeds were

available. The four alternating temperature combinations used were 25° C. day, and 5° C. night; 25° C. day, and 10° C. night; 20° C. day and 5° C. night, and 20° C. day and 10° C. night. The first two of these combinations proved to be far superior to the others as will be brought out later. Three peat media with pH's of 5.6, 7 and about 8 were used. The peat was neutralized or brought to its correct pH value by using calcium carbonate in the proper amounts. Fifty seeds were planted in each dish for all tests made.

Check or control sets

Two duplicate sets of checks or controls were conducted, one during the fall and the other during the spring. For these sets, the four alternating temperature combinations of 25° C. - 5° C., 25° C. - 10° C., 20° C. - 5° C., and 20° C. - 10° C. were used. The seeds of Ribes inerme, R. lacustre, R. nevadense, R. petiolare, R. roezli, and R. viscosissimum were planted on alkaline, neutral and acid peat media. This tested each of the six species on the three media in each of the four temperature combinations.

Results of germination in the two sets of control cultures were as follows:

TABLE NO. 3

FIRST SET OF CONTROL CULTURES

Temperature Combinations	Germination Media	Germination of Species by Month: R. inerme 1st Mo.	R. inerme 2nd Mo.	R. inerme 3rd Mo.	R. inerme Total	R. lacustre 1st Mo.	R. lacustre 2nd Mo.	R. lacustre 3rd Mo.	R. lacustre Total	R. nevadense 1st Mo.	R. nevadense 2nd Mo.	R. nevadense 3rd Mo.	R. nevadense Total	R. petiolare 1st Mo.	R. petiolare 2nd Mo.	R. petiolare 3rd Mo.	R. petiolare Total	R. viscosissimum 1st Mo.	R. viscosissimum 2nd Mo.	R. viscosissimum 3rd Mo.	R. viscosissimum Total	Totals 1st Mo.	Totals 2nd Mo.	Totals 3rd Mo.	Totals Total
25° to 5° C.	Alka.	-	-	3	3	14	16	5	35	-	3	7	10	-	-	-	-	-	-	-	-	14	19	15	48
	Neut.	-	1	-	1	2	15	12	29	-	4	12	16	-	-	-	-	-	-	-	-	2	20	24	46
	Acid	-	1	-	1	1	7	2	10	-	-	10	10	-	-	-	-	-	2	-	2	1	10	12	23
	Total	-	2	3	5	17	38	19	74	-	7	29	36	-	-	-	-	-	2	-	2	17	49	51	117
25° to 10° C.	Alka.	-	1	1	2	6	13	1	20	-	-	1	1	-	-	-	-	-	-	1	1	6	14	4	24
	Neut.	-	-	-	-	1	11	12	24	1	4	5	10	-	-	-	-	-	-	2	2	2	15	19	36
	Acid	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	1
	Total	-	1	1	2	7	24	13	44	1	4	6	11	-	-	-	-	-	1	3	4	8	30	23	61
20° to 5° C	Alka.	-	1	-	1	7	2	2	11	-	1	4	5	-	-	-	-	-	1	3	4	7	5	9	21
	Neut.	-	-	-	-	-	3	1	4	-	3	6	9	-	-	-	-	-	-	-	-	-	6	7	13
	Acid	-	-	-	-	-	1	2	3	-	1	2	3	-	-	-	-	-	-	1	1	-	2	5	7
	Total	-	1	-	1	7	6	5	18	-	5	12	17	-	-	-	-	-	1	4	5	7	13	21	41
20° to 10° C.	Alka.	-	-	-	-	1	3	1	5	-	-	-	-	1	-	-	1	-	1	-	1	2	4	1	7
	Neut.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	1	1	-	2
	Acid	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	1	3	1	5	-	-	-	-	1	-	-	1	1	2	-	3	3	5	1	9
Totals	Alka.	-	2	4	6	28	34	9	71	-	4	12	16	1	-	-	1	-	2	4	6	29	42	29	100
	Neut.	-	1	-	1	3	29	25	57	1	11	23	35	-	-	-	-	1	1	2	4	5	42	50	97
	Acid	-	1	-	1	1	8	4	13	-	1	12	13	-	-	-	-	-	3	1	4	1	13	17	31
	Total	-	4	4	8	32	71	38	141	1	16	47	64	1	-	-	1	1	6	7	14	35	97	96	228

No R. roezli germination was secured in either of these sets.

TABLE NO. 4

SECOND SET OF CONTROL CULTURES

Temperature Combinations	Germinations Media	Germination of Species by the Month: R. inerme 1st Mo.	R. inerme 2nd Mo.	R. inerme 3rd Mo.	R. inerme Total	R. lacustre 1st Mo.	R. lacustre 2nd Mo.	R. lacustre 3rd Mo.	R. lacustre Total	R. nevadense 1st Mo.	R. nevadense 2nd Mo.	R. nevadense 3rd Mo.	R. nevadense Total	R. petiolare 1st Mo.	R. petiolare 2nd Mo.	R. petiolare 3rd Mo.	R. petiolare Total	R. viscosissimum 1st Mo.	R. viscosissimum 2nd Mo.	R. viscosissimum 3rd Mo.	R. viscosissimum Total	Totals 1st Mo.	Totals 2nd Mo.	Totals 3rd Mo.	Totals Total
25° to 5° C.	Alka.	-	1	6	7	18	22	-	40	-	3	7	10	2	1	1	4	-	8	7	15	20	35	21	76
	Neut.	-	4	2	6	5	27	7	39	-	3	6	9	10	-	-	10	-	7	10	17	15	41	25	81
	Acid	-	4	5	9	-	-	-	-	1	9	19	29	8	1	-	9	-	4	4	8	9	18	28	55
	Total	-	9	13	22	23	49	7	79	1	15	32	48	20	2	1	23	-	19	21	40	44	94	74	212
25° to 10° C.	Alka.	1	5	3	9	8	18	1	27	-	-	-	-	13	3	2	18	-	1	1	2	22	27	7	56
	Neut.	1	7	-	8	2	17	-	19	-	1	2	3	29	3	2	34	-	1	-	1	32	29	4	65
	Acid	1	-	-	1	2	-	-	2	-	3	-	3	8	6	3	17	-	2	1	3	11	11	4	26
	Total	3	12	3	18	12	35	1	48	-	4	2	6	50	12	7	69	-	4	2	6	65	67	15	147
20° to 5° C.	Alka.	-	1	-	1	5	7	5	17	-	1	1	2	1	-	-	1	1	6	-	7	7	15	6	28
	Neut.	3	2	-	5	1	6	12	19	-	1	1	2	-	1	-	1	-	4	-	4	4	14	13	31
	Acid	2	-	-	2	7	4	7	18	-	-	2	2	-	-	-	-	-	1	-	1	9	5	9	23
	Total	5	3	-	8	13	17	24	54	-	2	4	6	1	1	-	2	1	11	-	12	20	34	28	82
20° to 10° C.	Alka.	1	1	-	2	4	2	1	7	-	-	-	-	-	-	-	-	2	4	1	7	7	7	2	16
	Neut.	-	-	-	-	-	1	-	1	-	2	-	2	1	-	-	1	-	-	-	-	1	3	-	4
	Acid	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	4	-	4	2	6
	Total	1	3	-	4	4	3	1	8	-	2	-	2	1	-	-	1	2	6	3	11	8	14	4	26
	Alka.	2	8	9	19	35	49	7	91	-	4	8	12	16	4	3	23	3	19	9	31	56	84	36	176
	Neut.	4	13	2	19	8	51	19	78	-	7	9	16	40	4	2	46	-	12	10	22	52	87	42	181
	Acid	3	6	5	14	9	4	7	20	1	12	21	34	16	7	3	26	-	9	7	16	29	38	43	110
Totals	Total	9	27	16	52	52	104	33	189	1	23	38	62	72	15	8	95	3	40	26	69	137	209	121	467

No. R. roezli germination was secured in either of these sets.

Germination was recorded by the month to show how soon after planting the seedlings appeared. The results for the two tables are practically the same except that more seeds germinated in the spring than in the fall. There was, however, on exception; R. nevadense showed practically the same germination for both sets. Of the four temperature combinations, the 25° C. -5° C. showed best germination for all species except R. petiolare, which preferred the 25° C.-10° C. combination. In nearly all the other cases the 25° C.10° C. combination was second in number of seeds germinated, 20° C.-5° C. third, and 20° C.-10° C. fourth.

R. petiolare reached its germination peak during the first month after planting, R. lacustre during the second month, R. inerme was on the border line between the second and third month, and R. nevadense and R. viscosissimum reached their peaks during the third month.

The species showed a wide variation in pH preference for the peat media. R. inerme germinated about equally well on all three media, R. lacustre preferred the alkaline medium, R. petiolare and R. viscosissimum showed a slight preference for a neutral medium, while R. navadense was on the border line between a neutral and acid medium.

The fact that more seeds of each species germinated in the second test than in the first, with the exception of R. nevadense which showed about the same in both tests, would indicate that a rest period was needed for best germination. The seeds of R. inerme, however, were three years old when used, yet the spring test gave more than six times as many seedlings as that of the fall test. This is hard to explain and does not verify the above indication. Regardless of this one exception, when the data are completely analyzed and the conditions thoroughly understood, it appears that R. lacustre, R. petiolare and R. viscosissimum benefited by a four to five-month rest period before germination.

Sodium chlorate sets

It has been observed during the past that large numbers of seedlings appear on an area that has been sprayed with sodium chlorate. The number of seedlings appears to be much greater than the ordinary amount that follows other sprays and other methods of Ribes eradication. One of the possible reasons for this is that the seeds are stimulated by the sodium chlorate spray. In spraying, a large amount of spray hits the ground directly and much more drips from the bushes during and immediately following the application. This solution soaks in the duff, sometimes aided by dew and rains. In most cases it is probably very much diluted by the time it reaches the base of the duff. Because of these facts and observations a

test was made in the laboratory using $NaClO_3$ as a Ribes germination stimulant.

Five concentrations were used based on parts of $NaClO_3$ per million parts of solution. These concentrations were based on decimal fractions of a molar solution and were to be expressed in milequivalents per liter of solution. When working up the data, however, it was decided that this system would be too hard for the average person to understand so the values were converted into their respective percentages thus giving the per cents expressed in odd fractions. Solution 1 contained 10,645 parts of $NaClO_3$ per million parts of solution or 1.0645 per cent, solution 2 contained 0.1065 per cent $NaClO_3$ solution 3 contained 0.0107 per cent $NaClO_3$, solution 4 contained 0.00107 per cent $NaClO_3$, solution 5 contained 0.000107 per cent $NaClO_3$, or one part of $NaClO_3$ per million parts of solution. The reason for such wide variations in concentration was to locate the killing solution and to establish a gradation from the killing solution down to one so dilute as to have no effect upon germination.

Air-dried peat was moistened to its saturation point with one of the solutions and then kept at this moisture content by adding distilled water throughout the period of germination.

A test was conducted in the fall of 1930 using four duplicate sets of seeds of Ribes inerme, R. petiolare and R. viscosissimum planted on alkaline, neutral and acid peat for each of the five $NaClO_3$ solutions. One set was then placed in each of the four temperature combinations of 25° C.-5° C., 25° C.-10°., 20° C.-5° C., and 20° C.-10° C. This tested the three species on the three peat media in four temperature combinations for each of the five $NaClO_3$ solutions. Practically no germination occurred in this test; and, as a result, no conclusions can be made.

Another test was conducted late in the spring of 1931 using the seeds of Ribes lacustre and R. petiolare, as the seeds of these two species had shown good germination in some of the early spring tests. These seeds were planted on alkaline, neutral, and acid peat for each of the five $NaClO_3$ solutions. The R. lacustre set was put in the 20° C.-5° C. temperature combination while the R. petiolare set was put in the 25° C.-10° C. combination since these were found to be their respective optimum temperature requirements.

The following table shows the results of this test:

TABLE NO. 5

SODIUM CHLORATE TESTED AS A GERMINATION STIMULANT

Species of Ribes at Their Optimum Germinating Temperature	Germination Media	Germination by Concentration of $NaClO_3$ by the Month																							
		Solution No.2				Solution No. 3				Solution No. 4				Solution No. 5				Control Set				Totals			
		1st Mo.	2nd Mo.	3rd Mo.	Total	1st Mo.	2nd Mo.	3rd Mo.	Total	1st Mo.	2nd Mo.	3rd Mo.	Total	1st Mo.	2nd Mo.	3rd Mo.	Total	1st Mo.	2nd Mo.	3rd Mo.	Total	1st Mo.	2nd Mo.	3rd Mo.	Total
R. lac. at 25° to 5° C.	Alka.	1	5	1	7	22	8	2	32	16	14	2	32	11	17	1	29	18	22	-	40	68	66	6	140
	Neut.	1	2	2	5	5	25	6	36	-	13	12	25	6	19	3	28	5	27	7	39	17	86	30	133
	Acid	-	1	1	2	6	25	2	33	-	5	13	18	-	17	6	23	-	-	-	-	6	48	22	76
	Total	2	8	4	14	33	58	10	101	16	32	27	75	17	53	10	80	23	49	7	79	91	200	58	349
R. pet. at 25° to 10° C.	Alka.	5	2	-	7	21	3	-	24	27	2	-	29	23	2	1	26	13	3	2	18	89	12	3	104
	Neut.	7	4	-	11	28	2	-	30	43	-	-	43	28	-	-	28	29	3	2	34	135	9	2	146
	Acid	3	1	-	4	29	1	-	30	35	2	1	38	36	1	-	37	8	6	3	17	111	11	4	126
	Total	15	7	-	22	78	6	-	84	105	4	1	110	87	3	1	91	50	12	7	69	335	32	9	376
,	Alka.	6	7	1	14	43	11	2	56	43	16	2	61	34	19	2	55	31	25	2	58	157	78	9	244
	Neut.	8	6	2	16	33	27	6	66	43	13	12	68	34	19	3	56	34	30	9	73	152	95	32	279
	Acid	3	2	1	6	35	26	2	63	35	7	14	56	36	18	6	60	8	6	3	17	117	59	26	202
Totals	Total	17	15	4	36	111	64	10	185	121	36	28	185	104	56	11	171	73	61	14	148	426	232	67	725

No results were obtained with solution No. 1.

An analysis of Table No. 5 gives the following indications: (1) that solution 1 was too concentrated to permit the germination of either species; (2) that R. lacustre was stimulated on aid peat but not on the other two media; (3) that germination of R. lacustre started the first month and reached its peak during the second month; (4) that for the total germination of R. lacustre, for the three media, the peak was reached in solution 3 while solutions 4 and 5 were about the same as the control set; (5) that R. petiolare was decidedly stimulated by solution 4; (6) that for R. petiolare germination was also stimulated in solutions 3 and 5 in the alkaline and acid peat media; (7) that practically all the germination for R. petiolare occurred during the first month of incubation, and (8) that future work should be concentrated around solutions 3 and 4 for these two species.

It was observed that as soon as germination occurred in solution 2 the tip of the radicle was already brown and in no case did the seedling survive after being transplanted to a neutral medium; thus indicating that the seedling was killed immediately upon germination.

At the termination of this test, the peat from the dishes was tested for $NaClO_3$, not as to amount but as to presence or absence. Solution 1 gave a heavy test, solution 2 a fair test, while solution 3 was very faint. No trace was found in solutions 4 and 5, but the method used might not have been sensitive enough to record such dilute solutions.

Hot water as a germination stimulant

Hot water was tried as a stimulant. The seeds were placed in hot water (97 C.) and allowed to remain for one minute. Cold water was then added and the seeds removed. The seeds of R. inerme, R. lacustre, R. nevadense, R. petiolare, R. roezli and R. viscosissimum treated in the above manner were placed on alkaline, neutral, and acid peat. These were then placed in the 25° C.-5° C. temperature combination. No germination occurred, so the only definite conclusion that can be made is that the water was too hot thus killing the seeds before they were planted.

Freezing as a germination stimulant

Some fruits of R. petiolare, R. roezli and R. viscosissimum were kept at a -10° C. for 4½ months; the seeds were then planted on alkaline, neutral, and acid peat. This set was placed in the 25° C.-5° C. temperature combination.

The results of this test are shown in the following table:

TABLE NO. 6

CULTURES IN WHICH SEEDS WERE FROZEN BEFORE PLANTING

Treatment of Seeds Previous to Germination	Germination Media	Germination by Species by the Month											
		R. petiolare				R. viscosissimum				Totals			
		1st Mo.	2nd Mo.	3rd Mo.	Total	1st Mo.	2nd Mo.	3rd Mo.	Total	1st Mo.	2nd Mo.	3rd Mo.	Total
Seeds which were frozen 4½ months and then planted	Alka.	14	2	1	17	1	-	-	1	15	2	1	18
	Neut.	18	2	-	20	-	10	1	11	18	12	1	31
	Acid	9	3	2	14	-	1	7	8	9	4	9	22
	Total	41	7	3	51	1	11	8	20	42	18	11	71
Checks unfrozen seeds	Alka.	2	1	1	4	-	8	7	15	2	9	8	19
	Neut.	10	-	-	10	-	7	10	17	10	7	10	27
	Acid	8	1	-	9	-	4	4	8	8	5	4	17
	Total	20	2	1	23	-	19	21	40	20	21	22	63
Totals	Alka.	16	3	2	21	1	8	7	16	17	11	9	37
	Neut.	28	2	-	30	-	17	11	28	28	19	11	58
	Acid	17	4	2	23	-	5	11	16	17	9	13	39
	Total	61	9	4	74	1	30	29	60	62	39	33	134

R. roezli seeds showed no germination.

A study of Table No. 6 indicates that the seeds of R. petiolare were stimulated by freezing before planting as the germination per cent for the frozen seeds was nearly twice that of the controls. This condition did not hold for R. viscosissimum but was practically reversed which showed that no stimulation occurred. None of the R. roezli seeds germinated.

Comparison of culture media

Two duplicate sets of seeds of R. lacustre were treated with 2 per cent, 4 per cent, 6 per cent, 8 per cent and 10 per cent solutions of sulphuric acid for five minutes. One set was planted on alkaline peat and the other set was planted on commercial blotting paper. The blotting paperhad a pH of 7. The two sets were placed in the 25° C.-5° C. temperature combination. This test was conducted for four months instead of the usual three.

The results of the comparison of culture media are as follows:

TABLE NO. 7

Comparison of Culture Media

Germination Media	Number of Months	Germination by Concentration of H_2SO_4					Totals and Averages		
		2%	4%	6%	8%	10%	Total	Average	Average in Per Cent
R. lacustre on alkaline peat	1st Mo.	36	34	38	35	38	181	36.2	72.4
	2nd Mo.	6	6	10	7	7	36	7.2	14.4
	3rd Mo.	-	2	-	1	-	3	0.6	1.2
	4th Mo.	1	3	-	-	-	4	0.8	1.6
	Total	43	45	48	43	45	224	44.8	89.6
R. lacustre on blotting paper	1st Mo.	30	33	23	27	20	133	26.6	53.2
	2nd Mo.	11	6	13	14	20	64	12.8	25.6
	3rd Mo.	1	3	4	1	2	11	2.2	4.4
	4th Mo.	-	-	-	-	-	-	-	-
	Total	42	42	40	42	42	208	41.6	83.2
Totals	1st Mo.	66	67	61	62	58	314	31.4	62.8
	2nd Mo.	17	12	23	21	27	100	10.0	20.0
	3rd Mo.	1	5	4	2	2	14	1.4	2.8
	4th Mo.	1	3	-	-	-	4	0.4	0.8
	Total	85	87	88	85	87	432	43.2	86.4

A comparison of the results of this study, as brought out in Table No. 7 shows that alkaline peat was the better medium in every case for R. lacustre, giving a total percentage of 89.6 against 83.2 per cent for blotting paper. When the results for blotting paper are compared with those of neutral peat (Table No. 8) for the same species under the same conditions, they appear to be about the same, as neutral peat showed a germination percentage of 80.

Sulphuric acid as a germination stimulant

Two different experiments were conducted testing H_2SO_4 as a Ribes germination stimulant and are referred to as higher and lower concentration sets. In the lower concentration set, the seeds of R. inerme, R. lacustre and R. viscosissimum were soaked in 2 per cent, 4 per cent, 6 per cent, 8 per cent and 10 per cent solutions of sulphuric acid for five minutes; then, after rinsing them in a 0.1 per cent solution of potassium bicarbonate, they were washed with distilled water and planted on alkaline, neutral, and acid peat. The set was placed in the 25° C.-5° C. temperature combination. This tested the tree species on three media for each of the five H_2SO_4 concentrations in the 25° C.-5° C. temperature combination.

The following table shows the results obtained with the lower concentrations:

TABLE NO. 8

LOWER CONCENTRATIONS OF SULPHURIC ACID TESTED AS GERMINATION STIMULANTS

Species of Ribes at 25°- 5° C.	Germination Media	Germination by Concentration of H_2SO_4 by the Month: 2 Per Cent H_2SO_4 1st Month	2nd Month	3rd Month	Total	4 Per Cent H_2SO_4 1st Month	2nd Month	3rd Month	Total	6 Per Cent H_2SO_4 1st Month	2nd Month	3rd Month	Total	8 Per Cent H_2SO_4 1st Month	2nd Month	3rd Month	Total	10 Per Cent H_2SO_4 1st Month	2nd Month	3rd Month	Total	Control 1st Month	2nd Month	3rd Month	Total	Totals 1st Month	2nd Month	3rd Month	Total	
	Alkaline	1	5	1	7	4	9	1	14	-	11	-	11	1	6	3	10	7	5	2	14	-	1	6	7	13	37	13	63	23 %
	Neutral	3	3	6	12	2	2	-	4	-	7	-	7	3	7	4	14	1	4	1	6	-	4	2	6	9	27	13	49	16 %
	Acid	2	5	6	13	1	1	-	2	-	2	-	2	4	8	-	12	-	1	1	2	-	4	5	9	7	21	12	40	13 %
R. inerme	Total	6	13	13	32	7	12	1	20	-	20	-	20	8	21	7	36	8	10	4	22	-	9	13	22	29	85	38	152	51 %
	Alkaline	34	10	1	45	33	13	1	47	35	10	-	45	30	12	-	42	28	18	-	46	18	22	-	40	178	85	2	265	88 %
	Neutral	13	14	4	31	28	11	2	41	19	23	1	43	24	16	2	42	13	28	2	43	5	27	7	39	102	119	18	239	80
	Acid	16	19	6	41	25	17	1	43	* -	-	1	1	20	12	3	35	16	17	2	35	-	-	-	-	77	65	13	155	52
R. lacustre	Total	63	43	11	117	86	41	4	131	54	33	2	89	74	40	5	119	57	63	4	124	23	49	7	79	357	269	33	659	
	Alkaline	10	22	2	34	4	9	-	13	2	20	3	25	5	23	5	33	6	16	4	26	-	8	7	15	27	98	21	146	49
	Neutral	2	10	1	13	4	24	8	36	3	24	6	33	4	15	2	21	3	17	1	21	-	7	10	17	16	97	28	141	47
	Acid	3	22	11	36	-	4	3	7	-	-	1	1	-	-	-	-	-	1	-	1	-	4	4	8	3	31	19	53	18
R. viscos-issimum	Total	15	54	14	83	8	37	11	56	5	44	10	59	9	38	7	54	9	34	5	48	-	19	21	40	46	226	68	340	
	Alkaline	45	37	4	86	41	31	3	74	37	41	3	81	36	41	8	85	41	39	6	86	18	31	13	62	218	220	36	474	
	Neutral	18	27	11	56	34	37	10	81	22	54	7	83	31	38	8	77	17	49	4	70	5	38	19	62	127	243	59	429	
	Acid	21	46	23	90	26	22	4	52	-	2	2	4	24	20	3	47	16	19	3	38	-	8	9	17	87	117	44	248	
Totals	Total	84	110	38	232	101	90	16	207	59	97	12	168	91	99	19	209	74	107	13	194	23	77	41	141	432	580	139	1,151	

*Mold ruined results.

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An analysis of Table No. 8 indicates: (1) that there was practically no difference in the stimulating effect of the five concentrations of H_2SO_4 with the exception of the 2 per cent concentration for R. viscosissimum which showed almost twice the total germination for the three media when compared with the other concentrations and the control; the total number of seeds germinated was slightly greater for the 2 per cent concentration than for any of the others including the control set, (2) that when the totals of the three media for each species are considered, stimulation occurred in practically all cases, (3) that R. lacustre was very definitely stimulated on acid peat, (4) that the optimum germination requirements are very nearly fulfilled for R. lacustre on alkaline peat, as from 84 to 94 per cent of the seeds germinated, and (5) that the germination occurred from one to two months sooner when the seeds were stimulated with the lower concentrations of sulphuric acid.

In the higher concentration test, four duplicate sets of seeds of R. inerme, R. lacustre, R. nevadense, R. petiolare, R. roezli and R. viscosissimum were soaked in 15 per cent, 20 per cent and 25 per cent solutions of H_2SO_4 for five minutes; then after rinsing them in a 0.1 per cent solution of potassium bicarbonate, they were washed with distilled water and planted on alkaline peat. A planted set was then placed in each of the four temperature combinations, 25° C.-5° C., 25° C.-10° C., 20° C.-5° C., and 20° C.-10° C. Alkaline peat was the only medium used because at the time this test was started indications were that it was the best medium, but later tests showed that these indications must be confined to certain species. It is probable, therefore, that maximum germination was not obtained from those species which preferred a more acid medium. This experiment tested the seeds of six species on alkaline peat in the four temperature combinations for each of the three sulphuric acid solutions.

TABLE NO. 9

HIGHER CONCENTRATIONS OF SULPHURIC ACID TESTED AS GERMINATION STIMULANTS

Temperature Combination	Concentration of H_2SO_4	Germination of Species by the Month																							
		R. inerme				R. lacustre				R. nevadense				R. petiolare				R. viscosissimum				Totals			
		1st Mo.	2nd Mo.	3rd Mo.	Total	1st Mo.	2nd Mo.	3rd Mo.	Total	1st Mo.	2nd Mo.	3rd Mo.	Total	1st Mo.	2nd Mo.	3rd Mo.	Total	1st Mo.	2nd Mo.	3rd Mo.	Total	1st Mo.	2nd Mo.	3rd Mo.	Total
25° to 5° C.	15%	5	3	2	10	21	11	1	33	-	7	2	9	32	-	-	32	-	1	-	1	58	22	5	85
	20%	-	2	2	4	14	15	4	33	3	3	1	7	34	-	-	34	1	1	2	4	52	21	9	82
	25%	1	3	3	7	7	20	3	30	1	2	1	4	27	-	-	27	2	5	-	7	38	30	7	75
	Total	6	8	7	21	42	46	8	96	4	12	4	20	93	-	-	93	3	7	2	12	148	73	21	242
25° to 10°C.	15%	6	7	-	13	2	1	-	3	-	1	-	1	49	-	-	49	-	-	-	-	57	9	-	66
	20%	-	3	-	3	4	3	-	7	2	2	2	6	42	-	-	42	2	1	-	3	50	9	2	61
	25%	-	3	-	3	6	9	-	15	2	1	2	5	45	-	-	45	1	2	1	4	54	15	3	72
	Total	6	13	-	19	12	13	-	25	4	4	4	12	136	-	-	136	3	3	1	7	161	33	5	199
20° to 5° C.	15%	-	-	-	-	-	2	5	7	-	-	2	2	28	-	-	28	-	1	-	1	28	3	7	38
	20%	-	-	-	-	-	-	-	-	-	1	-	1	21	-	-	21	2	-	1	3	23	1	1	25
	25%	-	-	1	1	-	3	3	6	1	-	1	2	30	-	-	30	-	-3	4	7	31	6	9	46
	Total	-	-	1	1	-	5	8	13	1	1	3	5	79	-	-	79	2	4	5	11	82	10	17	109
20° to 10°C.	15%	1	2	-	3	-	-	-	-	-	-	1	1	2	-	-	2	-	-	-	-	3	2	1	6
	20%	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	1	-	-	1
	25%	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	2	1	-	3	4	1	-	5
	Total	1	2	-	3	-	-	-	-	-	-	1	1	5	-	-	5	2	1	-	3	8	3	1	12
Totals	15%	12	12	2	26	23	14	6	43	-	8	5	13	111	-	-	111	-	2	-	2	146	36	13	195
	20%	-	5	2	7	18	18	4	40	5	6	3	14	98	-	-	98	5	2	3	10	126	31	12	169
	25%	1	6	4	11	13	32	6	51	4	3	4	11	104	-	-	104	5	11	5	21	127	52	19	198
	Total	13	23	8	44	54	64	16	134	9	17	12	38	313	-	-	313	10	15	8	33	399	119	44	562

No germination was obtained for R. roezli.

The results of Table No. 9 indicate: (1) that practically no difference was shown in the stimulating effect of the three sulphuric acid solutions upon the seeds, (2) that when compared with the controls in Table No. 4, germination seemed to be hindered instead of being stimulated for all the species except R. petiolare, (3) that the germination per cent of R. petiolare was very definitely increased over that shown by the controls even for that of neutral peat which appears to be the best medium for this species, (4) that one set of optimum germination requirements for R. petiolare have been completely fulfilled as the 15 per cent solution gave 98 per cent germination, (5) that the time required for germination was reduced about one month by the use of higher concentrations of sulphuric acid, and (6) that when the results of R. inerme and R. viscosissimum are compared with their respective results in Table No. 8, it is readily seen that the concentrations of the higher set are too strong for stimulating purposes for these species. No seeds of R. roezli germinated for either of the sulphuric acid tests.

Comparison of duplicate sets

One set of seeds was duplicated in the sulphuric acid tests. These two sets were run as parts of separate tests one being almost completed when the other was started. The latter offers a very good check upon the results of the former as the conditions under which they were conducted were identical. The seeds of R. lacustre were immersed in 2 per cent, 4 per cent, 6 per cent, 8 per cent and 10 per cent solutions of sulphuric acid for five minutes and then, after rinsing them in a 0.1 per cent solution of potassium bicarbonate, they were washed with distilled water and planted on alkaline peat. The 25° C. - 5° C. temperature combination was used. The results of this comparison are given below:

TABLE NO.10

COMPARISON OF DUPLICATE SETS OF H_2SO_4 STIMULATED SEEDS

Species and Sets	Month	Germination By Concentration of H_2SO_4					Totals and Averages		
		2 Per Cent	4 Per Cent	6 Per Cent	8 Per Cent	10 Per Cent	Total	Aver-age	Average in Per Cent
Ribes lacustre first set	1st Month	36	34	38	35	38	181	36.2	72.4
	2nd Month	6	6	10	7	7	36	7.2	14.4
	3rd Month	-	2	-	1	-	3	0.6	1.2
	Total	42	42	48	43	45	220	44.0	88.0
Ribes lacustre second set	1st Month	34	33	35	30	28	160	32.0	64.0
	2nd Month	10	13	10	12	18	63	12.6	25.2
	3rd Month	1	1	-	-	-	2	0.4	0.8
	Total	45	47	45	42	46	225	45.0	90.0
Totals	1st Month	70	67	73	65	66	341	34.1	68.2
	2nd Month	16	19	20	19	25	99	9.9	19.8
	3rd Month	1	3	-	1	-	5	0.5	1.0
	Total	87	89	93	85	91	445	44.5	89.0

An analysis of Table No. 10 shows: (1) that no one of the five sulphuric acid concentrations was favored by R. lacustre as a germinating stimulant, and (2) that results of the first and second tests were very consistent showing an average germination per cent of 88 and 90 respectively.

Determination of optimum pH by species

In order to determine the best pH medium for each species, all sets of data in which the three peat media were used are combined into one table. Data for the six species were included in only two sets, the other sets being run with a fewer number of species. The results are as follows:

TABLE NO. 11

DETERMINATION OF BEST pH MEDIUM FOR EACH SPECIES

Tests Upon Which Table is Based	Germination by Species on Peat Media																				Totals			
	R. inerme				R. lacustre				R. nevadense				R. petiolare				R. viscosissimum							
	Alkaline	Neutral	Acid	Total	Alkaline	Neutral	Acid	Total	Alkaline	Neutral	Acid	Total	Alkaline	Neutral	Acid	Total	Alkaline	Neutral	Acid	Total	Alkaline	Neutral	Acid	Total
First control	6	1	1	8	71	57	13	141	16	35	13	64	1	-	-	1	6	4	4	14	100	97	31	228
Second control	19	19	14	52	91	78	20	189	12	16	34	62	23	46	26	95	31	22	16	69	176	181	110	467
$NaClO_3$ Set	-	-	-	-	140	133	76	349	-	-	-	-	104	146	126	376	-	-	-	-	244	279	202	725
Low concentration of H_2SO_4	63	49	40	152	265	239	155	659	-	-	-	-	-	-	-	-	146	141	53	340	474	429	248	1,151
Frozen seed set	-	-	-	-	-	-	-	-	-	-	-	-	17	20	14	51	1	11	8	20	18	31	22	71
Totals	88	69	55	212	567	507	264	1,338	28	51	47	126	145	212	166	523	184	178	81	443	1,012	1,017	613	2,642

No germination of R. roezli seeds was secured.

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The results of Table No. 11 indicates: (1) that R. inerme, R. lacustre and R. viscosissimum prefer alkaline peat as a germination medium while neutral and acid peat were preferred in the order given, (2) that R. nevadense and R. petiolare prefer neutral peat as a germination medium followed by acid and alkaline respectively, (3) that for the five species showing germination, the medium containing more acid than the one giving the greatest germination per cent was the next in order of preference, and (4) that for some species there was very little difference between the best two media.

Determination of best temperature combination by species

The best temperature combination of those used was determined for each species by an analysis of all the data which included the four temperature alternations and the six species of Ribes. Only three tests or sets covered as broad a scope as that needed for this determination.

The results of this test are as follows:

TABLE NO. 12

DETERMINATION OF BEST TEMPERATURE COMBINATION

Temperature Combinations	Germination Media	Germination of Species by Sets																Totals			
		R. inerme				R. lacustre				R. nevadense				R. petiolare				R. viscosissimum							
		1st Control	2nd Control	Higher Concentration H_2SO_4	Total	1st Control	2nd Control	Higher Concentration H_2SO_4	Total	1st Control	2nd Control	Higher Concentration H_2SO_4	Total	1st Control	2nd Control	Higher Concentration H_2SO_4	Total	1st Control	2nd Control	Higher Concentration H_2SO_4	Total	1st Control	2nd Control	Higher Concentration H_2SO_4	Total
25° to 5° C.	Alkaline	3	7	21	31	35	40	96	171	10	10	20	40	-	4	93	97	-	15	12	27	48	76	242	366
	Neutral	1	6	-	7	29	39	-	68	16	9	-	25	-	10	-	10	-	17	-	17	46	81	-	127
	Acid	1	9	-	10	10	-	-	10	10	29	-	39	-	9	-	9	2	8	-	10	23	55	-	78
	Totals	5	22	21	48	74	79	96	249	36	48	20	104	-	23	93	116	2	40	12	54	117	212	242	561
25° to 10° C.	Alkaline	2	9	19	30	20	27	25	72	1	-	12	13	-	18	136	154	1	2	7	10	24	56	199	279
	Neutral	-	8	-	8	24	19	-	43	10	3	-	13	-	34	-	34	2	1	-	3	36	65	-	101
	Acid	-	1	-	1	-	2	-	2	-	3	-	3	-	17	-	17	1	3	-	4	1	26	-	27
	Totals	2	18	19	39	44	48	25	117	11	6	12	29	-	69	136	205	4	6	7	17	61	147	199	407
20° to 5° C.	Alkaline	1	1	1	3	11	17	13	41	5	2	5	12	-	1	79	80	4	7	11	22	21	28	109	158
	Neutral	-	5	-	5	4	19	-	23	9	2	-	11	-	1	-	1	-	4	-	4	13	31	-	44
	Acid	-	2	-	2	3	18	-	21	3	2	-	5	-	-	-	-	1	1	-	2	7	23	-	30
	Totals	1	8	1	10	18	54	13	85	17	6	5	28	-	2	79	81	5	12	11	28	41	82	109	232
20° to 10° C.	Alkaline	-	2	3	5	5	7	-	12	-	-	1	1	1	-	5	6	1	7	3	11	7	16	12	35
	Neutral	-	-	-	-	-	1	-	1	-	2	-	2	-	1	-	1	2	-	-	2	2	4	-	6
	Acid	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	4	-	6	-	6
	Totals	-	4	3	7	5	8	-	13	-	2	1	3	1	1	5	7	3	11	3	17	9	26	12	47
Totals	Alkaline	6	19	44	69	71	91	134	296	16	12	38	66	1	23	313	337	6	31	33	70	100	176	562	838
	Neutral	1	19	-	20	57	78	-	135	35	16	-	51	-	46	-	46	4	22	-	26	97	181	-	278
	Acid	1	14	-	15	13	20	-	33	13	34	-	47	-	26	-	26	4	16	-	20	31	110	-	141
	Totals	8	52	44	104	141	189	134	464	64	62	38	164	1	95	313	399	14	69	33	116	228	467	562	1,257

No germination was obtained for R. roezli.

The data were recorded by media, but as one set did not have a neutral or acid portion, the totals cannot be directly compared so as to determine the best media. The only conclusions that can be drawn are regarding the preferred temperature combination for each species, which are: (1) that R. inerme, R. lacustre, R. nevadense and R. viscosissimum show a definite preference for the 25° C.-5° C. temperature combination, with 25° C. - 10° C. being their second choice with the exception of R. viscosissimum which showed next best results in the 20° C.- 5° C. combination, (2) that R. petiolare prefers the 25° C. - 10° C. temperature combination giving next best results in the 25° C. - 5° C. combination and (3) that the temperature combination for each species is preferred strongly enough to be designated as the optimum temperature combination of those used.

Survival of seedlings

The seedlings were transplanted to special dishes as soon as the radicle had protruded far enough to indicate definite germination. Neutral peat was tried in Petri dishes and moistened with a 1/2 Hoagland nutrient solution once or twice each week with distilled water being used the remainder of the time. This method gave very good results. A clay loam was also tried in Petri dishes and moistened with a 1/2 Hoagland nutrient solution about once each week and being kept at its right moisture content the rest of the time with distilled water. This method gave only fair results as the soil packed down and caked when slightly dried. Another method was to use the clay loam in small flower pots. These were watered by setting the pots in a pan and letting the water soak up from the bottom, thus keeping the soil loose and in good shape. This method gave very satisfactory results but required more time than the Petri dish method. From 50 to 70 seedlings were planted in a Petri dish while 10 to 15 were all that could be planted in a flower pot. It was more difficult to get the seedlings started in the flower pots as there was no way to cover them to prevent rapid and excessive drying of the young plants which occurs immediately after transplanting from a covered dish. In cases where permanent plantings are wanted, the Petri dish method would not be applicable as the seedlings would have to be again transplanted; but for the purpose of studying the seedlings immediately after germination, a neutral peat medium in Petri dishes appeared to be best.

The above methods were used for the species that showed germination and proved equally well for all except R. viscosissimum which showed poor survival under all conditions. It appeared that seedlings of R. viscosissimum were very delicate and many would die before the cotyledons were out of the seed coat. Some seedlings were grown in Petri dishes until from 8 to 12 leaves had developed and were still showing rapid growth

when discarded.

SUMMARY

The Ribes germination study, which was conducted during the past year, has provided the following information:

1. Temperature combinations.

a. Ribes inerme, R. lacustre, R. nevadense and R. viscosissimum preferred the 25° C. - 5° C. temperature combination.

b. Ribes petiolare preferred the 25° C.- 10° C. temperature combination.

2. Germination stimulants.

a. A solution containing 106.45 parts of sodium chlorate per million parts of solution shows a marked stimulating effect upon R. lacustre seeds planted on acid peat.

b. A solution containing 10.65 parts of sodium chlorate per million parts of solution showed a stimulating effect upon the seeds of R. petiolare planted on any of the peat media.

c. Seeds of the species showing germination were stimulated by soaking them in a 2 to 10 per cent solution of sulphuric acid for five minutes before planting. R. lacustre reacted best to this stimulant.

d. Seeds of R. petiolare showed best germination when soaked in a 15 per cent solution of sulphuric acid for five minutes before planting.

e. Ribes petiolare showed a slight increase in germination when the seeds had been kept at -10° C. for 4½ months, but R. viscosissimum and R. roezli were not stimulated.

3. Germination media.

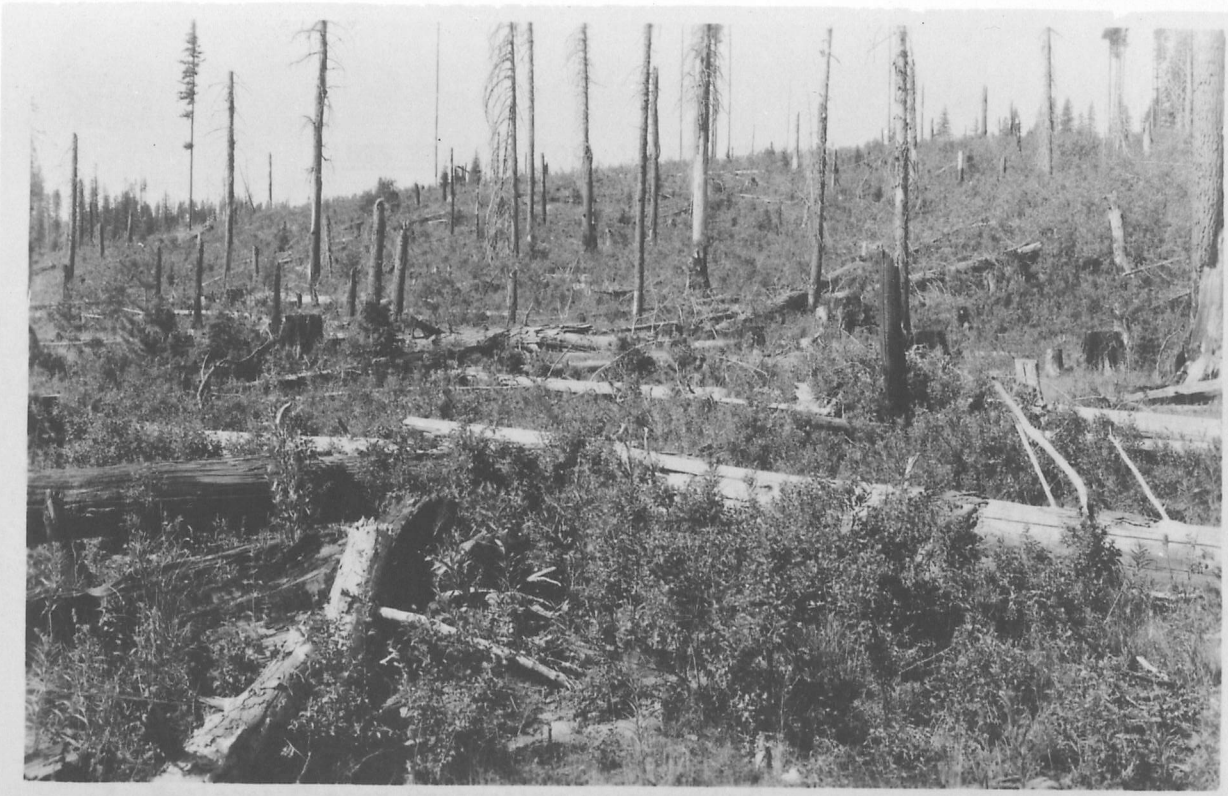
a. Ribes inerme, R. lacustre and R. viscosissimum preferred an alkaline peat germination medium.

b. Ribes nevadense and R. petiolare preferred a neutral peat germination medium.

4. Most species of Ribes seeds need a rest period before being germinated.

5. Ribes lacustre preferred alkaline peat to commercial blotting paper as a medium.

6. Best seedling survival was secured when the seedlings were transplanted to neutral peat in a Petri dish immediately following germination and then fed a nutrient solution.



W. 913. Cut-over, burned-over area in Cameron Creek drainage near Elk River, Idaho. Gradually reproducing to white pine, some of which is visible. This area to be photographed each year from same spot as a visible record of forest development.



W. 892. Typical stand of young white pine in the background, with R. petiolare and R. lacustre in stream type in the foreground. 200-300 bushes of R.viscosissimum and R.lacustre scattered thru reproduction. Area lies on Little Breakfast Creek about 10 miles north of Pierce,Ida.

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RIBES ERADICATION, INLAND EMPIRE, 1931

By
C. C. Strong
Associate Forester

The past year brought the greatest effort yet experienced in the Inland Empire to protect white pine from blister rust. No efforts was spared during the fall and winter of 1930-1931 to acquaint owners with the facts regarding the alarming local development of the rust. Little headway would have been made, however, had it not been that owners through first-hand knowledge had kept themselves informed of the actions of this pest. Hence their provision of funds was with the full knowledge that no time could be lost in having the control work done.

There was available for control work in the various administrative control units for the period April 1, 1931 to March 31, 1932, the following funds:

1. Clearwater National Forest	$160,700.00
2. Clearwater Timber Protective Association	60,000.00
3. Potlatch Timber Protective Association	30,000.00
4. Upper St. Maries River drainage	18,000.00
5. Priest Lake Timber Protective Association	15,000.00
Total	$283,700.00

In addition $14,255.00 was allotted to the development of field methods of eradicating wild Ribes. Although the primary purpose of the activities of the methods project is the testing of promising methods and further perfection of proven methods, the net results accomplished in controlling blister rust are far from negligible.

Owing to the size of the operations, annual reports for each project on a strictly control basis have been pared to the bare essentials. The results of the work of the methods project are fully discussed in the report for that project. The various reports have, as in the past, been made by the supervisor in charge of the operation.

This report serves as a general summary of work done in 1931, a discussion of various phases of the operation, and brief statements of what problems now seem most urgent for solution.

COST ANALYSIS

Rather than include the details regarding basic cost computations in each report on Ribes eradication, the method used is described below:

A. Salaries of Supervisors

Salaries of supervisors includes the full year's salary for

permanent employees.

B. Statement of Composite Cost Per Effective Man Day.

In estimating the probable cost of removing Ribes from a given area, it is essential to know what it costs per work day to keep a man busy pulling or spraying Ribes. Estimates are usually made on the basis of the actual man days work represented. Obviously there are many charges which must be taken into consideration in computing the average cost per effective man day. These charges are: (1) supervision, (2) subsistence, (3) equipment, (4) transportation, (5) repairs, and (6) miscellaneous supplies and expenses.

In addition to these charges there are the costs of preliminary Ribes eradication surveys, checking and year-round salaries of the permanent personnel necessary to man the job. All these must be included in arriving at the effective man day cost. When this figure is known, it represents the factor by which estimates on number of effective man days for a given piece of work may be directly converted into costs. Hence, it is very important that such a conversion factor be available. The method of arriving at the composite cost per effective man day is as follows:

From the total cost of the operation deduct the charge for rental and repair of spraying equipment and the charge for purchase and transportation of chemical. Divide this net total by the actual number of man days spent spraying or hand pulling Ribes. (This letter figure includes laborers and crew foremen only.) The result is the composite cost per effective man day for the operation.

The cost per man day for spraying is greater than for hand pulling because of the added charge for depreciation and repair of spraying equipment. To arrive at the composite cost per man day for spraying, the total spraying equipment charge (which includes repairing of such) was divided by the effective man days spent on spraying and the result added to the general composite cost per man day.

C. Cost of Spray for a Given Unit or Area.

This was arrived at as follows: The chemical charge (including cost and transportation of chemical and cost of glue) was divided by the total number of gallons of spray used. The result, of course, was the average cost per gallon of spray used on the operation. The cost of spray for a given area or unit was computed by simply multiplying the number of gallons of spray used on that unit by the average cost per gallon of spray.

SPRAY FORMULA AND SCHEDULE

In determining the spray formulas and schedules, Ribes eradication supervisors were guided by the technical recommendations of the men in charge of experimental chemical Ribes eradication investigations. The following were their recommendations:

1. From the beginning of the season until July 15 use a spray made by dissolving .5 pounds of sodium chlorate ($NaClO_3$) per gallon of water with the requisite amount of glue spreader and sticker solution added. *

2. Between July 15 and August 15 use a spray made by dissolving one pound of Atlacide (a commercial weed killer) per gallon of water with the requisite amount of glue spreader and sticker solution added.

3. During the balance of the spraying period use a spray made by dissolving one pound of sodium chlorate ($NaClO_3$) per gallon of water with the requisite amount of glue spreader and sticker solution added.

This schedule was adhered to so far as was possible.

PRECAUTIONS IN HANDLING CHEMICALS

To facilitate the management of such an enlarged operation, it was deemed advisable to issue a manual of Ribes eradication for the Inland Empire for use by camp bosses and crew foremen. These manuals proved of inestimable value in the direction of the work. Among other important points covered was a set of instructions incident to the use of chemicals on Ribes eradication. Inherent in the use of chemicals are certain dangers which, in all field operations, remain practical or theoretical dependent upon the care and intelligence exercised in handling these chemicals. The instructions issued were as follows:

"(1) Prohibit smoking where sodium chlorate, Atlacide or other chemicals are being stored or handled.

"(2) Keep floors of trucks used in transporting chemicals free from oil, grease and forest litter.

"(3) Avoid needless dropping and bumping of kegs.

"(4) Tie loads securely, either on trucks or on pack animals, to reduce friction and jostling as much as possible while en route.

*In general about one-third of a pint of this solution is used per ten gallons of spray.

"(5) Sweep up spilled chemical carefully and throw sweepings in running water or bury in mineral soil. Do not return dirty chlorate to original containers under any circumstances. This applies also to Atlacide.

"(6) Provide trucks, when used to transport chemicals, with Pyrene fire extinguishers.

"(7) Enforce rules regarding clothing as follows: work clothes worn while handling chemicals or while spraying must be washed thoroughly at least once a week. Bottoms of trouser legs to be stagged and hemmed so as not to come lower than six inches above the bottom of the heel. Frayed edges of cloth, when soaked with chlorate and dried, present a high hazard. Do not wear a cuff on the trouser leg, as it accumulates an excessive amount of the chemical. Clothing must not be allowed to dry out completely. Trousers worn while handling chemicals must be left on the job and others worn between camp and the place of work. Experiments being conducted at the present time may prove that it is advantageous to fire-proof clothing. In this case special instructions will be issued and the camp boss and foremen will be expected to enforce them.

"(8) Grease boots thoroughly and frequently during the entire spraying season to prevent them from absorbing chemical.

"(9) Prohibit smoking while person is wearing clothing worn while handling chemical.

"(10) Take reasonable care to prevent scratching and cuts of the skin. Each operator should rub a little vaseline into his hands morning and evening when handling chemicals.

"(11) Never store chemical near fire.

"(12) Keep kegs closed until empty Although there is little or no danger to animals from grazing sprayed material, there is danger if such are allowed to lap up the dry chemical, either from an open keg or from a spot where chemical was spilled and not properly disposed of. Kegs should never be open longer than for the time needed to remove chemical being mixed at the filling station.

"(13) Do not move damaged kegs into the field. The powder which runs out of the can in such cases might be ignited with disastrous results. Always thoroughly and promptly clean up spilled chemical, disposing of it as already stated (#5).

"(14) Locate filling stations, if possible, on sand or gravel

near a stream. If this is not practicable, they should be frequently and thoroughly soaked down with water, particularly in hot, dry weather. A careful clean-up should be made before leaving a filling station.

"(15) Patrol sprayed areas during hot, dry weather for at least three days following spraying.

"(16) Require that chemical drums, when empty, be thoroughly washed out in a creek and, if the stream is large enough and not being used at any point for drinking purposes or camp water supply, drums must be submerged in water. Each drum will be numbered. Each foreman will be required to report to his camp supervisor upon the disposal of each drum. As a double precaution, camp bosses must check sprayed areas to determine whether any drums were not properly disposed of. Should he find carelessness evident at any time, the crew foreman responsible will be held strictly accountable."

COOPERATION ON FIRE CONTROL

The year 1931 was one of the worst on record with regard to forest fires. Ribes eradication crews widely scattered in strategic locations over the white pine belt were called upon frequently. As a result the work of Ribes eradication suffered accordingly and many unfinished areas are the result. Work on the Clearwater National Forest was especially hindered in this respect.. This is a situation, however, which must normally be expected, the degree of interruption of Ribes eradication being proportional to the degree of hazardous fire weather conditions prevailing.

TYPES OF LABOR EMPLOYED

Previous to the depressing labor conditions now prevailing, about the only labor available for Ribes eradication was the student type with a sprinkling of local labor. In 1931 it was possible to secure a much larger percentage of this latter class which included a few lumberjacks, farmers, and better class of local natives who had been forced out of employment by industrial stagnation in the region. Conditions are such, at the present time that the following policy has been adopted for employing crews in 1932. First of all experienced men from crews employed in previous years, requisite to efficiently administer the work will be rehired. For the balance of the crew, unemployed men who have dependents and who are qualified to do the work will be hired. If there are still places to be filled, the usual policy of selecting the most promising men will be followed:

TABLE NO. 1

RESULTS OF WORK DONE IN 1931

The following brief summary shows the progress of Ribes eradication in 1931:

Administrative Area	Acreage		Cost of Work	Effective Man Days	Number Ribes Pulled	Gallons Spray Used
	Totally Protected	Partially Protected				
Priest Lake Timber Protective Association	12,571	-	$15,000.00	1,892	1,017,462	-
Upper St Maries River Drainage	6,430	-	18,000.00	2,585	416,128	20,647
Potlatch Timber Protective Association	1,599	33,960	30,000.00	3,862	1,006,889	6,980
Clearwater Timber Protective Association	-	52,530	60,000.00	7,635	1,410,911	71,040
Clearwater National Forest	50,292	20,073	145,432.71	18,556	5,471,453	78,075
All	70,892	106,563	$268,432.71	34,530	9,322,843	176,742

CHECKING THE EFFECTIVENESS OF WORK

Checking, as it is done at the present time, may be regarded as of two general types, each serving a specific purpose and the results of the two types combined serving as a general index of the quality and sufficiency of the work being done in securing adequate protection to white pine stands. The first type of checking has been properly termed administrative checking. Here the objective is to insure a type of work being done which will meet an acceptable standard. In 1931 this standard was regarded as 50 feet of live stem left per acre. Little information was available on which to base this decision so far as the epidemiology of the rust was concerned. Furthermore it was known as a result of past experiments that setting the standard too high would cause a rapid upward turn in the curve of costs per acre. The "50 feet of live stem left per acre" standard was a compromise based upon the meager epidemiological data available; a measure which would not result in a too rapid upward trend in costs.

The camp boss and operation or unit supervisors were required to

do the administrative checking. It was found that the camp boss could do his work most effectively by knowing exactly the type of work each crew was doing. Hence, such checking is a boon to him. Furthermore such checks substantiated by checks by unit and operations supervisors furnished the basic information needed to determine whether or not any areas should be reworked to bring about an acceptable standard of protection.

The second type of checking, which may be regarded as "effectiveness of control checks", was conducted by personnel of another project. Here the primary purpose is to secure basic information which will serve as a measure of the actual degree of protection afforded an area by a given piece of work, rather than whether or not the work done represents an acceptable standard of efficiency. Data secured serve both purposes but the former is the one emphasized. Through this type of checking progressive studies are made showing the annual Ribes growth increment following original Ribes eradication as well as that following reworkings. Such data make up a chronological record from which may be learned, (1) when reworking is needed, (2) correctness of original working methods as evidenced by type and quantity of regrowth of Ribes, (3) effectiveness of chemicals used as Ribicides, etc.

ANALYSES OF RIBES ERADICATION DATA

The information presented in the following tables is of great importance in the making of estimates of the cost of eradicating Ribes from areas proposed for protection and in the actual planning of the organization of field work. In Table No. 2 dealing with individual eradication types are included the Ribes eradication data by Ribes classes. Ribes class designates the number of bushes per acre. Table No. 2 deals with individual Ribes eradication types.

A. Hand Pulling

TABLE NO. 2

Stream

Ribes Class	Acres Worked	Man Days		Ribes Pulled Per Acre					
		Total	Per Acre	R. lac.	R. vis.	R. pet.	R. iner.	Other Ribes Species	Total
0-25	2,388.7	717.3	.30	11.5	1.6	.5	.7	-	14.3
26-50	1,740.5	709.1	.41	33.6	6.4	1.5	.6	*	42.1
51-100	3,105.1	1,486.4	.48	68.2	4.9	2.0	2.5	.1	77.7
101-200	4,907.2	3,163.7	.64	130.6	7.5	3.5	4.6	*	146.2
201-400	5,364.8	3,932.6	.73	243.2	11.2	9.7	13.1	.2	277.4
401-800	3,258.4	4,597.7	1.41	480.8	12.6	30.0	31.3	*	527.7
801-1600	1,072.3	2,239.2	2.09	840.3	21.9	71.8	98.1	-	1,032.1
1601-3200	164.4	538.1	3.27	1,401.1	5.6	75.4	319.6	-	1,733.8
3201 & up	12.6	77.2	6.13	2,090.1	-	132.1	2,009.7	-	4,293.2
All	22,014.0	17,461.3	.79	225.7	8.7	12.2	17.6	.1	264.3
Open Reproduction									
0-25	1,165.0	139.50	.12	2.2	4.3	*	*	.4	6.9
26-50	293.9	112.00	.38	7.3	29.3	.1	*	5.2	41.9
51-100	869.5	364.86	.42	8.2	62.9	.7	1.1	3.4	76.3
101-200	1,154.6	617.65	.54	31.9	99.4	1.0	1.5	8.9	142.7
201-400	1,077.5	886.10	.82	72.6	215.4	3.6	4.5	4.8	300.9
401-800	733.2	909.68	1.24	133.1	481.5	2.9	6.5	.3	624.3
801-1600	397.3	715.14	1.80	150.9	951.3	3.1	1.9	-	1,107.2
1601-3200	194.9	453.12	2.33	109.1	2,305.7	2.3	1.2	-	2,418.3
3201 & up	63.5	327.02	5.15	7.2	4,819.2	.3	*	-	4,826.7
All	5,949.4	4,526.07	.76	52.1	383.6	1.6	.2	3.5	441.0
Dense Reproduction									
0-25	1,500.2	152.8	.10	3.2	2.5	-	-	-	5.7
26-50	337.5	102.8	.30	15.1	17.0	.4	-	-	32.5
51-100	151.5	60.3	.40	38.2	25.2	-	2.0	-	65.4
101-200	118.5	84.9	.72	97.4	51.8	-	-	-	149.2
201-400	78.2	54.2	.69	201.7	58.1	-	-	-	259.8
401-800	4.0	3.0	.75	411.3	-	-	-	-	411.3
All	2,189.9	458.0	.21	20.4	11.0	.1	.1		31.6

*Represents a few bushes but not enough to amount to .05 bushes per acre.

TABLE NO. 2 (continued)

Open Pole

Ribes Class	Acres Worked	Man Days		Ribes Pulled Per Acre					
		Total	Per Acre	R. lac.	R. vis.	R. pet.	R. iner.	Other Ribes Species	Total
0-25	253.2	49.6	.20	9.3	10.3	1.2	-	-	20.8
26-50	42.0	7.5	.18	27.9	1.0	-	-	-	28.9
51-100	73.3	31.0	.42	53.2	14.6	-	-	-	67.8
101-200	156.7	113.6	.72	71.5	76.8	-	-	-	148.3
201-400	85.4	80.1	.94	150.5	101.1	-	-	-	251.6
401-800	6.9	8.5	1.33	355.7	147.1	20.1	-	-	522.9
801-1600	13.8	44.2	3.20	898.7	.1	-	-	-	898.8
1601-3200	.6	2.5	4.17	1,773.3	48.3	15.0	-	-	1,836.6
All	631.9	337.0	.53	76.6	40.2	.7			117.5

Dense Pole

0-25	59.5	18.0	.30	6.3	12.0	.1	-	-	18.4
26-50	58.0	23.9	.40	25.1	13.0	.9	-	-	39.0
51-100	27.0	8.4	.31	35.3	28.4	-	.8	-	64.5
101-200	57.5	29.8	.52	59.2	66.2	1.1	22.6	-	149.1
201-400	71.2	50.6	.71	155.8	70.8	9.3	10.5	-	246.4
401-800	3.0	3.9	1.30	-	580.0	-	-	-	580.0
All	276.2	134.6	.49	63.2	46.4	2.8	7.5		119.9

Open Mature

0-25	2,759.6	128.90	.05	6.1	.8	*	*	-	6.9
26-50	828.8	127.50	.15	30.3	7.8	*	.5	-	38.6
51-100	1,161.0	224.20	.19	60.3	11.9	.2	.2	-	72.6
101-200	1,750.7	784.86	.45	112.0	37.6	.4	1.5	-	151.5
201-400	1,031.0	525.10	.51	216.7	63.4	.1	4.5	-	284.7
401-800	379.2	348.60	.92	419.8	88.3	.5	34.5	-	543.1
801-1600	140.8	248.60	1.77	851.9	44.5	4.6	187.7	.1	1,088.8
1601-3200	25.6	66.00	2.58	862.3	938.5	5.0	60.4	-	1,866.2
3201 & up	2.5	8.50	3.40	1,546.4	1,484.4	44.4	880.8	-	3,884.0
All	8,079.2	2,462.26	.30	102.3	27.4	.3	6.4	*	136.4

Dense Mature

0-25	1,098.0	40.6	.04	5.7	.6	-	-	-	6.3
26-50	51.5	7.5	.15	33.4	1.4	-	-	-	34.4
51-100	80.5	10.9	.14	67.2	4.6	-	-	-	71.8
101-200	126.0	29.2	.23	150.2	4.9	-	-	-	155.1
201-400	62.0	21.1	.34	242.2	.4	-	-	-	242.6
All	1,418.0	109.3	.08	33.3	1.2	-	-	-	34.5

*Represents a few bushes but not enough to amount to .05 bushes per acre.

TABLE NO. 3

RIBES ERADICATION DATA BY RIBES SPECIES BY ERADICATION TYPE

Eradication Type	Acres Worked	Man Days		Ribes Pulled Per Acre					
		Total	Per Acre	R. lac.	R. vis.	R. pet.	R. iner.	Other Ribes Species	Total
Stream	22,014.0	17,461.30	.79	225.7	8.7	12.2	17.6	.1	264.3
Open Reproduction	5,949.4	4,526.10	.76	52.1	383.6	1.6	.2	3.5	441.0
Dense Reproduction	2,189.9	458.00	.21	20.4	11.0	.1	.1	-	31.6
Open Pole	631.9	337.00	.53	76.6	40.2	.7	-	-	117.5
Dense Pole	276.2	134.60	.49	63.2	46.4	2.8	7.5	-	119.9
Open Mature	8,079.2	2,462.30	.30	102.3	27.4	.3	6.4	-	136.4
Dense Mature	1,418.0	109.30	.08	33.3	1.2	-	-	-	34.5
All	40,558.6	25,488.60	.63	154.4	58.7	6.9	11.4	.5	231.9

TABLE NO. 4

RIBES ERADICATION DATA BY RIBES SPECIES BY RIBES CLASS

Ribes Class	Acres Worked	Man Days		Ribes Pulled Per Acre					
		Total	Per Acre	R. lac.	R. vis.	R. pet.	R. iner.	Other Ribes Species	Total
0-25	9,137.6	1,216.7	.13	6.6	2.1	.2	.2	.1	9.2
26-50	3,352.2	1,140.3	.34	28.4	9.2	.8	.5	.5	39.4
51-100	5,467.9	2,185.9	.40	55.7	16.4	1.3	1.7	.6	75.7
101-200	8,357.8	4,804.0	.58	110.1	28.7	2.5	3.4	1.2	145.9
201-400	7,770.1	5,549.8	.71	213.8	48.4	7.3	10.4	.8	280.7
401-800	4,384.7	5,871.4	1.34	416.8	98.2	22.9	27.3	.1	565.3
801-1600	1,624.2	3,247.1	2.00	667.7	251.0	48.6	81.5	-	1,048.8
1601-3200	385.5	1,060.7	2.75	713.8	1,230.5	33.8	155.2	-	2,133.3
3200 & Up	78.6	412.7	5.25	442.6	3,964.9	24.6	350.2	-	4,782.3
All	40,558.6	25,488.6	.63	154.4	58.7	6.9	11.4	.5	231.9

B. Spraying.

TABLE NO. 5

ANALYSES OF DATA FOR STREAM TYPE RIBES

Gallons per Acre	Acres	Man Days		Gallons Spray		Gallons Spray Per Man Day
		Total	Per Acre	Total	Per Acre	
0-5	518	157	.30	1,581	3	10
6-10	608	424	.70	4,881	8	12
11-20	712	564	.79	9,923	14	18
21-40	1,046	1,357	1.30	30,691	29	23
41-80	830	1,770	2.13	47,911	58	27
81-160	504	1,888	3.77	56,908	113	30
161-320	124	697	5.62	22,737	183	33
321 & Up	13	169	13.00	5,364	413	31
All Classes	4,355	7,026	1.61	179,996	41	26

SPECIAL PROBLEMS CONFRONTING RIBES ERADICATION PROJECT

1. Inability to effect complete kill of R. petiolare with one application of sprays now in use.

For some unaccountable reason good kills are secured on some areas while on other apparently similar areas given the same treatment, unsatisfactory kills of R. petiolare result.

2. Lack of a method of killing R. petiolare bushes which are partially submerged in sloughs and beaver dams during the working season. It has been found that spraying and respraying with sprays now in common use is ineffective so far as satisfactory kills are concerned.

3. The development of a satisfactory system of checking work done. It is hoped the system outlined in the preceding pages will effect still further improvements in the service rendered Ribes eradication crews by adequate checks.

4. Completion of upland Ribes eradication to enhance the value of stream type work already done on given areas.

The rust is now such a direct threat that it is feared much damage will result on areas from which stream type Ribes have been removed before the upland areas can be covered.

5. Determination of a standard which will judge the effectiveness of Ribes eradication as a control measure.

Obviously it is impractical to attempt 100% Ribes eradication. The problem is just how much live stem of Ribes can be tolerated under given conditions.

6. Failure of spraying and other methods to kill R. inerme bushes.

There are extensive areas having heavy concentrations of R. inerme. It is too costly to hand pull these bushes. Some other means must be found which will do the job at a cost which is not prohibitive. The use of burning and complete removal of the brush type by heavy machinery show some promise.

7. Construction of a master working plan for blister rust control on each administrative unit.

With blister rust in its present stage of development in the Inland Empire and the adjoining region north of the International Boundary, it is obvious that protection to white pine stands must be done on a selective basis. The most valuable areas must be given first consideration. At the present time there is not sufficient information available for some administrative units on which to make the selection. It is planned to speed the assembling of the further data needed and to incorporate them into a master plan for the guidance of Ribes eradication activities in the future.

PREERADICATION SURVEYS

During the fall of 1931 surveys were made on nearly 500,000 acres on the national forests and protective associations of north Idaho. The information secured was that needed for planning Ribes eradication on those areas proposed for treatment in the near future and covers the following points:

1. What areas have sufficient white pine values to warrant protection.

2. The approximate funds needed to treat each working unit having the necessary values.

3. The amount of chemical needed to treat R. petiolare on each working unit.

4. The most advantageous camp locations.

5. The organization required to complete each working unit in a given period of time.

Reports on preeradication surveys made on other than national forests will be found incorporated in individual reports. Areas covered on the Clearwater National Forest are as follows:

1. The Moose City Basin lying largely in township 40 north, range 11 east.

2. Lake and Goose Creek drainages lying east of Cedar Ranger Station.

3. North Fork of the Clearwater between the Cedars and the mouth of Kelly Creek.

4. Cold Springs Creek drainage.

5. Rock, Quartz, Skull and Isabella creek drainages lying largely within the Canyon Ranger district.

6. The Little North Fork of the Clearwater drainage lying within township 41 north, range 6 east, and the Bear Creek drainage adjoining on the north.

On the St. Joe National Forest the following drainages lying largely within the Avery and Slate creek ranger districts were covered: Big Creek, Slate Creek, Little North Fork of the St. Joe River, Loop Creek, North Fork of St. Joe River between Avery and Bogle's Spur and Fishhook Creek.

STUDIES ON HAND ERADICATION METHODS, 1931

By
Herman E. Swanson
Agent

The question has frequently arisen as to the most economical and effective method of obtaining a high efficiency in Ribes eradication work in hand pulling methods. Two possible methods have been given trial.

1. Carefully working over an area once.

2. Working an area rapidly the first time followed by one or more reworkings of the same area by picked men.

The first of these methods has proved very costly in the past and has not been entirely satisfactory in obtaining a high efficiency. Some past investigations have shown that the second method has real merit.

The work which was done along these lines during 1931 was performed on the lands of the Priest Lake Timber Protective Association by the men who conducted the experiments on chemical eradication methods on the same area.

The cost of the hand eradication experiments is included in the report on chemical eradication methods.

Experimental work was started on reworking methods in Ribes eradication to determine:

1. The cost necessary to reduce the amount of Ribes live stem on an area to 100 feet and less per acre.

2. The most satisfactory size of crew to rework areas within five or ten days after the initial Ribes eradication is done.

3. The number of times it would be practical to rework an area during the same season.

The experiments demonstrated that a high efficiency can be secured at a relatively low cost by reworking areas a few days following the first eradication. Practically all dominant bushes are found. Results tend to show that a 1-man crew on reworking is the most satisfactory. High efficiency can be obtained varying from 10 feet of Ribes live stem to 100 feet left per acre at costs varying from one-fifth to one-twentieth of the

cost of the first eradication work.

Additional experiments will be conducted along these lines to determine the actual relation of costs of reworking to the efficiency of the work measured in amount of Ribes live stem left per acre. These studies will also include methods designed to speed up the first eradication work and to secure a proper standard of Ribes efficiency at a lower cost by reworking methods.

STUDIES ON CHEMICAL ERADICATION METHODS

1931

By
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Agent

INTRODUCTION

The scope of experimental work in the development of chemical eradication methods included studies and tests on the following:

1. Seasonal toxicity of 5%, 7-1/2% and 10% concentrations by weight of Atlacide and sodium chlorate sprays.

2. Salt applications in dry form used in solution to the soil on large scale basis.

3. Stem, root and crown injections of copper complex on Ribes.

4. Dusting with Atlacide.

5. Effectiveness of sodium chlorate on Ribes when applied to aerial portions of the bushes and to the soil. Use of sodium chlorate in respraying R. inerme during current season.

6. Effect of variations in volume of water used in sodium chlorate applications per unit area compared with effect of variations in weight of sodium chlorate used per unit area.

7. Best utilization of chemical in spraying individual bushes.

8. Toxicity of various chemicals applied in dry form to the soil.

9. Equipment for spraying, dusting and injecting Ribes with chemicals.

For the most part, the experiments involving soil applications were concerned with the problem of killing R. inerme.

Checks were made upon all the experimental plots at the close of the season. These checks consisted of a careful inspection of roots, stems and buds to determine the condition of the bush. Any inspection made during the current season permits only a qualified statement as to the condition of the plants and the probable results, which may or may not be in accord with the true results obtainable by an inspection made the following year.

LOCATION AND DESCRIPTION OF AREA

The experiments were conducted on Orogrande Creek on the Clear-

water National Forest. The area contained heavy concentrations of R. inerme, R. petiolare and R. lacustre on wide bottoms bordering the stream. The area was representative of the conditions under which R. inerme is found, with bushes heavily distributed through dense patches of willows, alder and other deciduous growth. These conditions represent a serious problem in Ribes eradication work.

A small amount of work was done on R. inerme on the Priest Lake Timber Protective Association.

ORGANIZATION AND COST OF WORK

The work was carried on by a crew of eight men employed during the period from June 1 to September 5.

TABLE NO. 1

COST OF METHODS WORK, CALENDAR YEAR 1931

Item of Expenditure		Cost	
		Per Item	Total
Salaries & Wages	Supervisors	$ 3,429.99	
	Temporary Field Men	3,631.80	$ 7,061.79
Subsistence	Wages of Cook	294.67	
	Transportation of Food	45.32	
	Cost of Food	567.54	
	Annual Charge Subsistence Equipment	100.00	
	Meals Served Methods Men in Priest Lake Assn. Camps	603.40	1,610.93
General Equipment	Annual Charge	373.17	
	Repairs	37.31	
	Transportation	22.00	432.48
Chemical Equipment	Cost	* 974.44	
	Transportation	35.65	
	Repairs	410.28	1,420.37
Miscellaneous	Supplies	109.27	
	Expenses	277.28	
	Twine	** 25.00	
	Cost Government Car	361.31	772.86
Chemical Charges	Cost	1,221.67	
	Transportation	471.32	1,692.99
Grand Total			$12,991.42

*$493.85 of this for models of new equipment such as injectors, etc.
**Estimated.

WORK PERFORMED AND RESULTS

A. Toxicity of 5%, 7-1/2% and 10% Concentrations by Weight of Atlacide and Sodium Chlorate During Different Periods of the Season.

TABLE NO. 2

SEASONAL TOXICITY OF ATLACIDE AND SODIUM CHLORATE SPRAYS APPLIED TO AERIAL PORTION OF RIBES BUSHES

Chemical	Date of Spraying 1931	No. Acres in Plot	Gals. of Chem. Per Acre	Results Indicated by Sample Check Sept. 15-17, 1931					
				Per Cent Dead		Per Cent Questionable		Per Cent Live	
				R. pet.	R. lac.	R. pet.	R. lac.	R. pet.	R. lac.
5% Atlacide	June 10-15	3.7	124	65	45	20	30	15	25
7-1/2% Atlacide	June 16-19	1.0	140	75	-	20	-	5	-
10% Atlacide	June 20, July 2	1.5	223	72	60	15	35	12	5
5% Sodium Chlorate	July 2-6	1.7	138	67	52	20	33	13	15
7-1/2% Sodium Chlorate	July 7-11	2.0	178	35	50	30	36	15	14
10% Sodium Chlorate	July 11-24	.8	188	83	65	8	25	9	10
5% Atlacide	July 24-Aug. 7	1.6	91	61	-	32	-	7	-
10% Atlacide	Aug. 8-11	1.8	144	64	-	28	-	8	-
5% Sodium Chlorate	Aug.12	1.0	110	52	42	36	40	12	18
10% Sodium Chlorate	Aug. 13-15	2.0	143	55	47	34	41	11	12
5% Sodium Chlorate	Aug. 17-31	5.9	124	Sprayed too late for checking during same season.					
10% Sodium Chlorate	Aug. 17-31	2.8	154	do.					

Percentages listed in this table do not refer to the number of bushes but refer to the percentage of total stem in each bush condition class.

1. Definition of Terms:

Dead refers to stem which is on bushes which were entirely killed by the treatment.

Questionable refers to stem which is on bushes which may or may not survive. Either the roots or stems of these bushes have not shown sufficient injury to classify them as dead.

Live refers to stem on bushes which will probably survive.

2. Weights of Chemical:

	Atlacide	Sodium Chlorate*
5% Solution	0.7 lbs. per gal.	0.5 lbs. per gal.
7-1/2% Solution	1.0 lbs. per gal.	.75 lbs. per gal.
10% Solution	1.4 lbs. per gal.	1.00 lbs. per gal.

*These weights were used for sodium chlorate sprays in place of the true weights which are: .45 lbs., .675 lbs., and .9 lbs. respectively. This was done to have the weights conform with the schedulesused by regular eradication crews.

3. Discussion of Results:

On account of the large amount of stem on bushes in a questionable state of survival, the figures in Table No.2 represent only a preliminary check of the results. Since this is especially the case on areas sprayed during August, no statement relative to the seasonal effect on the toxicity of chemicals can be made at this time. With respect to the tests of the comparative toxicity of the several chemical concentrations, during June and July the 10% concentrations were 11% to 24% more effective on R. petiolare and 25% to 35% more effective on R. lacustre than the 5% concentrations as estimated on the basis explained in Table No. 2. On areas sprayed during the first fifteen days of August, this spread in effectiveness as indicated by the check was reduced. For reasons already set forth it is not advisable to base any conclusions regarding the spraying performed in August.



W. 946. Selective application of crystal common salt to crowns of R. lacustre and R. petiolare.



W. 946-1. Condition of R. lacustre and R. petiolare six weeks after application of salt.

B. Salt (NaCl) Applications to Soil.

TABLE NO. 3

RESULTS OF SALT APPLICATIONS TO SOIL

Plot No.	Acres in Plot	Form in which Applied	Method of Application	Gallons Per Acre When Applied in Solution	Man Days Per Acre		Salt Per Acre	
					No.	Cost	Pounds	Cost
1	0.2	Dry	By Hand to Ribes Crowns	-	49	$392	9,500	$191
2	0.6	Dry	Broadcast by Hand	-	15	120	14,000	281
3	0.35	Solu-tion	Broadcast by Power Equipment	4,200	10	90	2,100	42
4	0.7	Solu-tion	Broadcast by Power Equipment	9,700	20	180	9,700	195
5	1/80	Dry	Broadcast by Hand	-	-	-	16,000	321
6	1/80	Dry	do.	-	-	-	8,000	161
7	1/80	Dry	do.	-	-	-	4,000	80

Man Day = $8.00 when no equipment is required.
Man Day = $9.00 when power spraying equipment is used.
Cost of salt = $20.80 per ton.
Cost of transporting salt to the job = $19.40 per ton.
Salt applied July 8 to August 4, 1931.

Discussion of Results:

Reference is made to Plots 1 and 2 on which 5 man days per acre were required to soak down the salt with water following the application of the dry salt. This time is included in the above table. The number of man days listed for Plots 3 and 4 includes the number of man days required to mix the salt into solution for the man spraying. In each case, an equal number of man days were required to prepare the solution and tend the motor as were required to apply the solution to the plots. In these drenching methods there isno doubt that labor costs could be greatly reduced with the use of adequate equipment.

With respect to the effectiveness of the treatments, observations made on October 10 revealed the following results:

Plot No. 1 indicated that in selective application the salt was not sufficiently distributed to reach all the Ribes roots. The kill on Ribes will be about 75% to 80% in the case of R. inerme and R. lacustre and somewhat less in the case of R. petiolare.

Plot No. 2 indicated that practically all the vegetation on the plot will die. Approximately 90% to 95% of the R. inerme and R. lacustre will apparently be killed. In the case of R. petiolare, there was some resprouting taking place and it was difficult to judge what the final results on this species might be. Since about 25% of the salt was undissolved at the time of the observations, further action is probable.

Plot No. 3 showed very little killing effect from the treatment. Much vegetation on the Plot was still alive including R. petiolare and R. inerme.

Plot No. 4 showed that there will be a high percentage of kill on all vegetation. Although the kill will apparently not be as complete as on Plot No. 2 the general condition of the two plots seemed about the same.

No checks were made on Plots 5, 6 and 7 as they were established late in the season.

Observations showed that there was deposited a salty exudation on the under surface of the leaves of all deciduous plant species on the plots. These observations excluded leaves located where salt spray could have reached them during the process of application.

While the applications of salt as made in this experiment may not prove to be a practical method of Ribes suppression because of excessive costs, these treatments demonstrate a possibility for entirely destroying plant life on an area.

C. Stem, Root and Crown Injection.

TABLE NO. 4

SUMMARY OF INJECTION EXPERIMENTS WITH COPPER COMPLEX

No of Acres	No. of Man Days	Gallons of Copper Complex	Approximate Efficiency	Per Acre	
				Man Days	Gals. Copper Complex
2.4	17.5	4	40%	7.3	1.7

By means of a special tool, a copper complex was injected into the stems, roots and crowns of Ribes bushes. The labor and material involved in this experiment represent a maximum in the use of this method. Effort was made to find the crowns and main roots of all Ribes bushes. These, together with all the main stems, were injected. Although there were some variations in regard to the number of injections which were made on the bushes, by and large, the treatments were numerous and heavy.

The paste which was used was ineffective on R. inerme, R. lacustre and R. petiolare, three species on which it was tried. There was little movement of the chemical downward or around the stems through the cambium layer. In most cases, the stem was killed above the point of application. No satisfactory results were found on even the bushes which were given the heaviest injections. Approximately 40% to 50% of the live stem on the area was killed, while a smaller proportion of the root centers were destroyed.

Although this method is ineffective as far as this particular paste is concerned, it is possible that with a more highly toxic paste, injection methods may prove successful. On the basis of the work performed in this experiment, any paste requiring root and crown injections to be effective will involve labor costs of $60 to $70 on similar areas. Using a paste which does not require injection into crowns and roots to be effective, labor costs will be greatly reduced for injections can be made into aerial stems without much difficulty. The locating of roots and crowns involves a considerable amount of the time and makes the method costly as far as labor is concerned.

A tool designed on the principle of a pair of pliers served very well for the purpose. Injections of the paste were made easily and swiftly. If the method is to be tried further, a tool based upon the principle of a scarifier rather than an injector may serve to get more chemical into the cambium layer.

D. Dusting with Atlacide.

This experiment was performed on a small scale late in August with a dusting machine purchased from the Chipman Chemical Company. Promising results were found on the plot, which was checked on October 10, 1931. Much of the live stem was in a questionable state of survival. On the whole, dusting seemed to be more effective than aerial spraying on R. inerme and R. lacustre. This seemed to be the direct result of two conditions. These species appeared to be killed where the dust had been applied heavily and some had spread over the ground. Also, the leaves of the bushes remained green and apparently functioned for several days while the chemical

stuck to them. It appeared that about 60% of the bushes of these species would be killed. The method was effective on R. petiolare.

The results of the work show that 4.4 man days and 430 pounds of Atlacide were required per acre. This would bring the cost to about $65.00 per acre. The method of application cannot become practicable until a suitable dusting machine is devised. Considerable difficulty was experienced with the machine used which accounts somewhat for the high cost of the work. No uniformity could be maintained in the amount of dust applied because the workings of the machine became clogged. With proper control over the spreading of the dust, much chemical could be saved. The difficulties experienced with the machine also had a direct effect on the time required to do the work.

E. Use of Sodium Chlorate and Atlacide for Aerial and Soil Applications in Successive Treatments.

The methods employed were:

1. First treatment.

a. First spraying. Using nozzle having orifice slightly larger than No. 111 Fine.

(1) Spraying aerial portion of the Ribes to the point of dripping.

(2) Spraying ground representing the root distribution of the Ribes to the point of puddling.

2. Second treatment.

a. Respraying. Using nozzle having orifice about 1/8 inch.

(1) Plot No. 1. The roots of all R. lacustre and R. inerme bushes were heavily drenched whether they appeared to be alive or dead. The aerial portion of any releafing or re-sprouting Ribes was sprayed.

(2) Plot No. 2. Roots only of all R. lacustre and R. inerme bushes were heavily drenched whether they appeared to be alive or dead. The aerial portion of resprouting R. petiolare was sprayed.

(3) Plot No. 3. Roots and aerial portion of resprouting Ribes only were sprayed heavily.

(4) Plot No. 4. Roots only of resprouting R. lacustre and R. inerme bushes were heavily drenched. Aerial portion of resprouting R. petiolare was sprayed.

b. Hand pulling.

(1) Plot No. 5. All resprouting Ribes were pulled by hand.

(2) Plot No. 6. All R. lacustre and R. inerme, whether they appeared alive or dead were pulled by hand. Resprouting R. petiolare was pulled by hand.

TABLE NO. 5

AERIAL AND SOIL APPLICATION WITH SODIUM CHLORATE AND ATLACIDE SPRAYS

First Treatment					Second Treatment						Total on Plots Per Acre			
			Per Acre						Per Acre					
Date	No. Acres	Chemical	Man Days	Gallons Spray	Plot No.	Date	No. Acres	Chemical	Man Days	Gals. Spray	Man Days	Gals. Spray	Pounds Chem.	Approximate Cost
June 18-29	11.6	1.4# Atlacide Per Gallon	2.9	149	1	Aug. 8-14	5.5	2# Atlacide per gallon	2.0	84	4.9	233	377	$73.13
					2	Aug. 15-20	6.1	2#Atlacide per gallon	2.1	88	5.0	237	385	74.65
					3	Aug. 22-25	5.7	1# $NaClO_3$ per gallon	1.5	64	5.0	247	156	54.04
					4	Aug. 27-31	9.0	1# $NaClO_3$ per gallon	1.8	98	5.3	281	190	59.50
June 29 to Aug.1	20.6	0.5# $NaClO_3$ Per Gallon	3.5	183	5	Sept. 2-4	3.0	*	2.4		5.9	183	92	55.48
					6	Sept. 5-10	2.9	**	2.5		6.0	183	92	56.48

* 128 bushes pulled by hand.
** 109 bushes pulled by hand.
Man day = $8.00, 1# chemical= $0.09.

The first spraying was done with power equipment and the second spraying was done with knapsack equipment.

The costs of performing this work were high. Some of the factors contributing to this can be eliminated in a going operation on a larger scale. In the first place a trained crew performing this type of work for a longer period would become more efficient. Secondly, the power equipment developed for aerial spraying was not adapted to handling the larger volume of spray required for ground application. The first treatment of an area is essentially a job for the proper use of power equipment. It seems likely that better adapted equipment will perform the work more economically. Thirdly, a heavier application at the time of the first treatment has the possibility of eliminating a follow-up treatment or at least making it a simple operation. On this latter point some information is available from another experiment. With these considerations in mind, it is estimated on the basis of work performed in the past that 2-1/2 man days would be required to cover an acre with two treatments, and applying approximately 200 pounds of chlorate during the operation. This would make the cost about $40.00 per acre which would represent a maximum cost in view of the fact that the figures are based on work performed on the heaviest concentrations of Ribes growing under severe working conditions.

TABLE NO. 6

EFFECTIVENESS OF CHLORATE SPRAYS IN AERIAL AND SOIL APPLICATIONS AS INDICATED BY A PRELIMINARY CHECK ON PLOTS

Plot No.	Date of Last Work on Plots	Date of Checking	R. inerme			R. lacustre			R. petiolare		
			Per Cent Dead	Per Cent Questionable	Per Cent Live	Per Cent Dead	Per Cent Questionable	Per Cent Live	Per Cent Dead	Per Cent Questionable	Per Cent Live
1	Aug. 14	Sept.15	61.0	29.0	10.0	73.0	15.0	12.0	90.0	6.7	3.3
2	" 20	"	76.9	14.7	8.4	72.8	17.7	9.5	78.6	13.4	8.0
3	" 25	"	69.2	20.4	10.4	69.6	15.6	14.8	70.0	14.6	15.4
4	" 31	"	64.2	24.8	11.0	75.3	12.8	11.9	75.5	13.3	11.2
5	Sept. 4	"	60.8	27.0	12.2	-	-	-	-	-	-
6	" 10	"	56.3	31.3	12.4	-	-	-	-	-	-

Definition of terms: Dead, questionable, live given under Table No. 2.

An observation made on October 10 indicated that many of the bushes which seemed to be in a questionable state of survival on September 15 were gradually dying. The roots on bushes classified as dead were black and decaying, while those on bushes in a questionable condition were gradually approaching that state. Unless the bushes which will apparently survive develop toovigorously, all the Ribes on the sprayed plots should be practically destroyed, making a clean-up operation simple.

Attention is called to plots 3 and 4 on which the spraying was done later in the season. The amount of live stem on questionable bushes is high for the three Ribes species. Normally a kill of 95 per cent or more on R. petiolare can be expected. Using this as a possible guide for final results, the entire amount of questionable bushes and possibly some of the bushes classified as live will be killed. Since the action of the chemical was not complete on R. petiolare at the time of the inspection, there is hope that further action will take place on R. lacustre and R. inerme, especially considering the fact that the killing of these two species is dependent upon root action.

3. Application of chlorate solutions on other areas. These applications were made on heavy R. inerme concentrations on the North Fork of East River on the Priest Lake Timber Protective Association. Spray was applied to the aerial portion of the Ribes, and to the soil representing the root distribution of the bushes. Knapsack spraying equipment was used. No checks were made in 1931 to determine the effectiveness of the treatments.

TABLE NO. 7

RESULTS OF SPRAYING R. INERME CONCENTRATIONS ON THE PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION

Plot No.	Acres in Plot	Spray Used	First Application			Second Application		
			Date	Man Days	Gallons	Date	Man Days	Gallons
1	2.8	7½% Atlacide	June 24-27	13.5	463	Aug.17-18	5.5	155
2	3.5	10% "	June 29-July 3	17.0	546	Aug.19-20	7.5	218
3	1.5	10% $NaClO_3$	July 6-8	10.5	333	Aug. 21	4.0	113
4	1.0	5% "	July 9-11	8.0	236	Aug. 22	4.0	118

F. Use of $NaClO_3$ in Solution for Soil Drenches

These treatments were made late in August and the plots were checked on October 9. At this time all the plots showed the usual effects of the dropping of leaves and a general dead appearance.

The treatments requiring 32 gallons and 16 gallons of water per square rod were showing the greatest root and stem injury. The amount of chemical per square rod which seemed to be effective was 1 to 4 pounds in the 32-gallon treatments and 2 to 4 pounds in the 16-gallon treatments. The treatment calling for one pound $NaClO_3$ in 32 gallons of water appeared most effective at this time. In the smaller volumes, a treatment of 4 gallons and 4 pounds of $NaClO_3$ to the square rod showed results comparable to some of the heavier drenches. With this exception, the lighter drenches were not as effective as the heavier. There were no plots on which 1/2 pound of chemical was applied, regardless of the volume of solution used, which were showing any appreciable Ribes injury. These observations can only be taken as indications of what has taken place. The relative effectiveness of these treatments may change as further action takes place.

TABLE NO. 8

SOIL DRENCHES - SHOWING AMOUNT OF $NaClO_3$ USED IN EACH VOLUME OF WATER APPLIED PER SQUARE ROD

Weight of $NaClO_3$ Per Square Rod	1/2 Pound	1 Pound	2 Pounds	4 Pounds
Number of gallons of water per square rod	2	2	2	-
	4	4	4	4
	8	8	8	6
	16	16	16	16
	32	32	32	32

It must be borne in mind that these treatments constitute a 100% coverage of the plot. On areas in Idaho which have the heaviest concentrations of Ribes, it would not be necessary to cover more than 50% of the ground in order to reach all the roots of the Ribes. Seldom does a Ribes concentration constitute more than 35% or 40% of the ground cover.

In this experiment no chemical was applied to the aerial portion of the bushes. Although there will be a high percentage of R. lacustre and R. inerme killed, root treatments alone seem ineffective on R. petiolare.

This experiment must be supplemented by one in which the aerial portions of the Ribes are sprayed at the same time the soil drench is supplied, using the same solution for both purposes in order to kill R. petiolare and to determine whether any better kill on the other species is obtained.

G. Individual Bush Study Involving the Use of Different Volumes and Concentrations of $NaClO_3$ Applied to Aerial and Root Portions of the Bushes.

The purpose of this experiment is to determine the best utilization of chemical and in so far as possible to provide some basis upon which to describe how heavily a bush should be sprayed.

On account of the variation in size of bushes, no statement can be made as to what unit of volume should be applied to a bush. There are two places of application in spraying, the aerial portion of the bush and the ground below it. The aerial portion can be sprayed until it drips and the ground can be sprayed until puddles are formed or run off takes place. These are descriptions which can be understood and followed closely by a temporary laborer. Also he would be able to follow fairly well a description such as twice or three times these amounts.

In conjunction with these considerations, the experiment was varied to obtain a test on the best utilization of sodium chlorate in relation to volume of water used and the portion or portions of the bush to which applied.

Explanation of variables:

X = Volume of water required to cause leaves and stems to drip.
X' = Amount of $NaClO_3$ required in X to make a 10% solution.
Y = Volume of water required to cause leaves and stems to drip and to start to form puddles on the ground at the base of the bush.
Y' = Amount of $NaClO_3$ required in Y to make a 10% solution.

The values of X and Y vary according to the size of the bushes, and were determined in the case of each bush by first spraying it with water and measuring the volume required.

These symbols are used in couplets in the discussion, the first referring to volume of water and the second to the amount of $NaClO_3$ as designated for the values of X and X', Y and Y'.

TABLE NO. 9

SPRAYING TREATMENTS APPLIED TO INDIVIDUAL RIBES BUSHES

Aerial Application		Ground Application		Combined Aerial and Ground Application	
Volume of Spray	Amount of $NaClO_3$	Volume of Spray	Amount of $NaClO_3$	Volume of Spray	Amount of $NaClO_3$
X	X'	X	X'		
		Y	Y'	Y	Y'
		3Y	Y'	3Y	Y'*
		4Y	Y'	4Y	Y'*
		3X	X'	3X	X'*
		4X	X'	4X	X'*
		3X	3X'	3X	3X'*
		4X	4X'	4X	4X'*

*These treatments were not given a trial during 1931.

Fifty bushes of each species were treated: R. petiolare, R. lacustre and R. inerme. Five bushes were used for each treatment.

Mx = .151 gallons (average number of gallons to spray the aerial portion of bushes treated in this experiment).

My = .328 gallons (average number of gallons to spray the aerial portion of bushes and the ground below the bushes treated in this experiment).

Y = 2.17X. For 1 unit of volume required to spray the aerial portion of a bush to the point of dripping, 2.17 units were required to spray the aerial portion in this manner and the ground below the bush to the point of puddling.

The spraying of the individual bushes was done August 30 to September 1. A preliminary check was made on October 8. The following treatments were showing the best results at that time.

1. On R. petiolare X + X' aerial application. This is an application of 10% sodium chlorate solution to the aerial portion of the bush to the dripping point. Y + Y' aerial and ground application combined. This is an application of 10% sodium chlorate solution to the aerial portion of the bush to the dripping point and to the ground to the point of puddling.

2. On R. lacustre and R. inerme. Y + Y' aerial and ground application combined. This treatment was showing the best results. Other treatments showing good results were ground applications with the following volumes and concentrations:

3X + 3X', 4X + 4X', 3Y + Y' and 4Y + Y'.

It is hazardous to make any final comparisons on the basis of this inspection. The action taking place on these bushes seems to be in line with the results on the drenching plots, but the action had not been completed.

With a 10% solution of $NaClO_3$, a complete coverage of all the aerial portion of R. petiolare to the point of dripping seems sufficient to kill. Care must be taken to cover all the stem, as well as the leaves, with spray. Any additional ground application than that which results from spraying the aerial portion of the bush and spraying the stem down to the crown or base seems to add very little to the effectiveness of the treatment. The dose of spray applied at the crown or base of the stem no doubt follows down the root to some extent. This action seems essential in order to assure a 100% kill. The ineffectiveness of ground treatment alone on R. petiolare is also indicated in the salt and soil drenching experiments.

Aerial spraying alone has no permanent effect on R. lacustre and R. inerme. Ground applications cause considerable injury varying with the volume of water and the amount of chemical used. Changes in the volume of water when used with a fixed amount of chemical seemed to be the most important of the two factors. It seemed that the possibilities for a permanent kill on the bushes receiving ground treatment only were not as promising as those on bushes receiving both aerial and ground treatments. Apparently these species can be killed by ground treatment alone, but a smaller volume of spray and amount of $NaClO_3$ are required to accomplish this end when the spray is distributed over the stems and leaves of the bush as well as the ground.

This study on individual bushes is lacking in one essential point, and that is the testing of the dilute spray solutions in aerial and ground applications combined. These treatments will be tested during the coming season.

A serious difficulty encountered in this individual bush study comes in the application of the solution to the ground in order to cover the ground representing the root distribution of the bushes. In this experiment, the solution was applied to a relatively small piece of ground

just around the crown of the bush. There was no way of knowing whether all roots extending some distance from the bush were reached by the application of the solution. This particular point is taken care of in the drenching plots.

H. Soil Application of Chemicals in Dry Form

These experiments are outlined for broadcast treatments with chemicals in dry crystalline form on areas heavy in Ribes concentration. They are established on the basis of a maximum figure of $200 per acre and a minimum of $50 per acre for material, transportation and labor. All the treatments are based on a complete ground coverage. Ordinarily, under Idaho conditions, an application to 50% of the area would be sufficient to reach all the ground covered by the heaviest Ribes concentrations.

The following chemicals were used as shown in Table No. 10: sodium chlorate, ammonium chloride, sodium hydroxide, zinc chloride and calcium chloride.

TABLE NO. 10

CHEMICALS AND AMOUNTS USED FOR 1 SQUARE ROD APPLICATIONS

Chemical	At the Rate of 4 Tons Per Acre		At the Rate of 2 Tons Per Acre		At the Rate of 2 Ton Per Acre	
	Chemical	Amount	Chemical	Amount	Chemical	Amount
$NaClO_3$ 25%	Atlacide	21#	Atlacide	10#	Atlacide	5#
$CaCl_2$ 75%	$CaCl_2$	29#	$CaCl_2$	15#	$CaCl_2$	7#, 8 ox.
$NaClO_3$ 10%	Atlacide	8#, 4 oz.	Atlacide	4#	Atlacide	2#
$CaCl_2$ 90%	$CaCl_2$	41#, 12 oz.	$CaCl_2$	21#	$CaCl_2$	10#, 8 oz.
$NaClO_3$ 5%	Atlacide	2#, 8 oz	Atlacide	2#	Atlacide	1#, 8 oz.
$CaCl_2$ 95%	$CaCl_2$	47#, 8 oz.	$CaCl_2$	23#	$CaCl_2$	11#
NH_4Cl 50%	NH_4Cl	25#	NH_4Cl	12#, 8 ox.	NH_4Cl	6#, 4 oz.
$CaCl_2$ 50%	$CaCl_2$	25#	$CaCl_2$	12#, 8 oz.	$CaCl_2$	6#, 4 oz.
NH_4Cl 25%	NH_4Cl	12#, 8 oz.	NH_4Cl	6#, 4 oz.	NH_4Cl	3#, 2 oz.
$CaCl_2$ 75%	$CaCl_2$	37#, 8 oz.	$CaCl_2$	18#, 12 oz.	$CaCl_2$	9#, 6 oz.
NH_4Cl 10%	NH_4Cl	5#	NH_4Cl	2#, 8 oz.	NH_4Cl	1#, 4 oz.
$CaCl_2$ 90%	$CaCl_2$	45#	$CaCl_2$	22#, 8 oz.	$CaCl_2$	11#, 4 oz.
NH_4Cl 5%	NH_4Cl	2#, 8 oz.	NH_4Cl	1#, 4 oz.	NH_4Cl	10 oz.
$CaCl_2$ 95%	$CaCl_2$	47#, 8 oz.	$CaCl_2$	23#, 12 oz.	$CaCl_2$	11#, 14 oz.
NaOH 50%	NaOH	25#	NaOH	12#, 8 oz.	NaOH	6#, 4 oz.
$CaCl_2$ 50%	$CaCl_2$	25#	$CaCl_2$	12#, 8 oz.	$CaCl_2$	6#, 4 oz
NaOH 25%	NaOH	12#, 8 oz.	NaOH	6#, 4 oz.	NaOH	3#, 2 oz.
$CaCl_2$ 75%	$CaCl_2$	37#, 8 oz.	$CaCl_2$	18#, 12 oz.	$CaCl_2$	9#, 6 oz.
NaOH 10%	NaOH	5#	NaOH	2#, 8 oz.	NaOH	1#, 4 oz.
$CaCl_2$ 90%	$CaCl_2$	45#	$CaCl_2$	22#, 8 oz.	$CaCl_2$	11#, 4 oz.
NaOH 5%	NaOH	2#, 8 oz.	NaOH	1#, 4 oz.	NaOH	10 oz.
$CaCl_2$ 95%	$CaCl_2$	47#, 8 oz.	$CaCl_2$	23#, 12 oz.	$CaCl_2$	11#, 14 oz.
$ZnCl_2$ 50%	$ZnCl_2$	25#	$ZnCl_2$	12#, 8 oz.	$ZnCl_2$	6#, 4 oz.
$CaCl_2$ 50%	$CaCl_2$	25#	$CaCl_2$	12#, 8 oz.	$CaCl_2$	6#, 4 oz.
$ZnCl_2$ 25%	$ZnCl_2$	12#, 8 oz.	$ZnCl_2$	6#, 4 oz.	$ZnCl_2$	3#, 2 oz.
$CaCl_2$ 75%	$CaCl_2$	37#, 8 oz.	$CaCl_2$	18#, 12 oz.	$CaCl_2$	9#, 6 oz.
$ZnCl_2$ 10%	ZnCl	5#	$ZnCl_2$	2#, 8 oz.	$ZnCl_2$	1#, 4 oz.
$CaCl_2$ 90%	$CaCl_2$	45#	$CaCl_2$	22#, 8 oz.	$CaCl_2$	11#, 4 oz.
$ZnCl_2$ 5%	$ZnCl_2$	2#, 8 oz.	$ZnCl_2$	1#, 4 oz.	$ZnCl_2$	10 oz.
$CaCl_2$ 95%	$CaCl_2$	47#, 8 oz.	$CaCl_2$	23#, 12 oz.	$CaCl_2$	11#, 14 oz.
NaOH 44%			NaOH	11#, 2 oz.	NaOH	5#, 9 oz.
NaF 56%			NaF	13#, 14 oz	NaF	6#, 15 oz.
$CaCl_2$ 100%			$CaCl_2$	25#	$CaCl_2$	12#, 8 oz.
NH_4Cl 100%			NH_4Cl	25#	NH_4Cl	12#, 8 oz.
$ZnCl_2$ 100%			$ZnCl_2$	25#	$ZnCl_2$	12#, 8 oz.

These applications were made on September 6, 1931. Thirty-four days after treatment, very little effect from the chemicals was noticeable. Some root and stem injury had resulted from treatments where sodium chlorate had been applied in the amounts of 5 pounds and over per square rod. Permanent kill may result on these plots. The zinc chloride and ammonium chloride treatments had some effect as signs of injury were showing up on both stems and roots. A permanent kill from these two chemicals looked extremely doubtful, unless further action takes place during the winter.

Supplementing these experiments the following mixtures were applied in the amounts of less than one ton per acre. On account of the small amounts of chemical used, it was necessary to apply them in solution for a broadcast treatment.

TABLE NO. 11

CHEMICALS AND AMOUNTS USED FOR ONE SQUARE ROD APPLICATIONS (APPLIED IN SOLUTION, 16 GALLONS PER SQUARE ROD)

Chemical	Amount	Rate Per Acre
Sodium hydroxide	1-1/2 lbs.	
Sodium fluoride	1-7/8 lbs.	540 lbs.
Sodium hydroxide	3 lbs.	
Sodium fluoride	3-3/4 lbs.	1,080 lbs.
Ammonium chloride	3-3/8 lbs.	540 lbs.
Ammonium chloride	6-3/4 lbs.	1,080 lbs.

Thirty-four days after application, no effect had taken place. The leaves were still on the Ribes bushes.

RECOMMENDATIONS FOR FUTURE CONTROL WORK

A. Spraying R. petiolare. Results obtained through the use of a 5% concentration of sodium chlorate in 1931 were apparently not satisfactory on any of the Ribes eradication projects in Idaho. Areas sprayed with a 5% solution required a second application in many cases. This added considerably to the cost of eradication through labor required and chemical used. Although the 5% solution apparently proved unsatisfactory in 1931, the results with a 5% solution in 1930 on the Musselshell district were more favorable.

Preliminary inspection of the experimental plots on the Orogrande showed the 10% solution to be much more effective than the 5%. However, the

10% concentration as it has been applied has not given a complete kill. With the information available, the 10% concentration appears to be preferable to the 5%. This assumption should be verified by an early spring inspection on several areas of the final results obtained from the use of both concentrations.

Aerial spraying appears to be a practical and effective method of killing R. petiolare. This spraying should be done more thoroughly than it has been done in the past. The opinion has been widespread that R. petiolare requires little spray to kill it and this may have given rise to an unwarranted conservation of chemical. This attitude may also have caused incomplete spraying and the resulting ineffectiveness of the treatment. This type of result generally necessitates immediate reworking of the areas. On the basis of these considerations and results indicated in other experiments the following method is recommended for spraying R. petiolare:

1. A thorough saturation with spray of all leaves and all stems until they drip.

2. An application of spray to the base of the bush where it enters the ground.

B. Treatment of R. inerme and R. lacustre. On the basis of present information the following method for killing R. inerme and R. lacustre in place is recommended as the most effective:

1. An application of a 5% solution of sodium chlorate to all the leaves and stems of the Ribes to the point of dripping.

2. A soil application of the same solution beyond the point of puddling on the ground representing the root distribution of the bushes.

The first treatment is essentially a job for power equipment, while any follow-up treatment is probably a knapsack spraying job.

The heaviest Ribes concentrations should require about 400 gallons of solution per acre using this method. If follow-up chemical treatment is necessary, it should be done during the current season if practicable, otherwise during the following season. Some variations in the method will probably be required under conditions where the ground is covered with a mass of forest litter which prevents soaking the ground without use of an enormous amount of solution.

The recommendations set forth are subject to change on the basis of an early spring inspection of the experimental plots. However, satisfactory results seem to be secured with a maximum of 200 pounds of sodium chlorate per acre, and any change will probably come in the volume of water to be used.

Early spring spraying using the above method is also recommended.

RECOMMENDATIONS FOR FUTURE EXPERIMENTAL WORK

1. Continuation of testing the seasonal effect on the toxicity of sodium chlorate sprays. Especially is there a lack of information on this point regarding very early season applications.

2. Continuation of testing the effectiveness of various concentrations of sodium chlorate sprays to determine to what extent ineffectiveness is governed by concentration of chemical used as compared to incomplete application.

3. Further experimentations in combination of aerial and soil application of sodium chlorate solutions.

4. Further experimentation in soil application of sodium chlorate solutions.

5. Further experimentation in follow-up treatments.

6. Further experimentation in application of dry chemicals to the soil, using those chemicals showing significant results in last season's work.

7. Further experimentation on individual bushes to determine the most satisfactory method of spraying.

8. Further testing of ammonium thiocyanate as a Ribicide. This chemical has been rather extensively used by experimentars in other lines of work with promising results. Small scale tests of the chemical as a Ribicide were made in 1931 by the chemical investigative project of the Division of Blister Rust Control and full investigations are planned for 1932. Should the spring investigations show that 1931 applications were effective, sufficiently large scale applications of ammonium thiocyanate should be made by the methods project in 1932 partially to further corroborate the findings following previous applications and partially to develop methods of applying this chemical.

9. Dusting as a means of Ribes eradication. Any satisfactory test of applying chemical in the form of dust is dependent upon the development of a suitable dusting machine.

10. Many of the tests described in this report were made late in the season. All the above experiments should be conducted during early season, midseason, and late season periods.

11. Development of equipment.

a. Change in power equipment to handle about 250 gallons per hour.

b. Detailed study on nozzles and the proper sized orifice to be used. The experiments which were conducted in 1928 testing the size of nozzle to be used were performed with a different type of equipment than that which is now in use on spraying operations. The spraying was done with the idea of conserving spray and consequently the bushes were sprayed lightly. Experience is showing that R. petiolare requires a heavy covering of spray in order to kill it. These experiments need to be made with nozzles of No. 111 Fine orifice which are now in use and with others of graduated sizes.

EXPERIMENTAL AND FIELD EQUIPMENT

By
John F. Breakey
Agent

SUPPLEMENT TO REPORT ON CHEMICAL ERADICATION METHODS

INTRODUCTION

The development of new apparatus and the improvement and maintenance of present equipment for the chemical eradication of Ribes is the function of equipment study and experimentation.

DEVELOPMENT OF NEW EQUIPMENT

Injection Tools

An instrument for the injection of chemicals into plant stems and crowns was designed which operates like an ordinary pair of pliers with one V-shaped jaw and one jaw supporting a cutting edge, the blade being set to fit into the groove in the other jaw when they are closed. A chemical paste is supplied from a small portable pressure tank through a 1/4" hose to a passage through one handle of the tool and thence to the cutting edge. Outlets provided in this blade release the chemical paste within the plant stem when the incision is made. A thumb lever on the handle of the tool through which the paste is forced serves to operate a needle valve and to regulate the flow of paste.

Two of these tools were constructed for field use. Six to seven hundred individual injections can be made in an 8-hour working day with each.

The Chipman Chemical Duster

A portable dusting apparatus purchased from the Chipman Chemical Engineering Company was given a trial in applying Atlacide dust to Ribes. This apparatus is a knapsack outfit in which the dust is forced out by a bellows arrangement operated by a hand lever.

The machine was not satisfactory when Atlacide was used. The association of air and Atlacide with its hygroscopic agent causes the dust to become heavy and to stick to those parts of the machine with which it comes in contact. After one or two hours of operation the working parts inside the hopper as well as the outlets become clogged.

Aluminum Pack Frames

Aluminum tubing was used for the construction of special pack

frames and several of these frames were given a trial in the field. Although they were an improvement over the wooden frames in that the aluminum bows retained their shape, the sodium chlorate spray reacted with the aluminum to cause a complete breakdown in the structure of the metal. This type of pack frame cannot be used on operations where chlorate sprays are used unless the metal can be protected by a coating of paint.

Hand Pumps

The following changes were made on pumps of the No. 3 Type A model (illustration in 1930 annual report) to strengthen and make them more durable.

Use of metals with greater tensile strength for plungers.

a. Welded Monel tube.
b. Welded nichel tube.
c. 14-gauge seamless hard brass tube.
d. 16-gauge hard brass tube.

The pumps equipped with the above types of plungers were used throughout the season. The nickel and the 16-gauge hard brass plunger were equally satisfactory. The 16-gauge hard brass plunger is recommended for future use in the construction of the pumps since this metal can be purchased for less than nickel and does not require polishing in the course of manufacture.

Hand Pump Pressure Equalizer

In cooperation with the Forest Service, experimental work was undertaken to perfect an apparatus for maintaining a constant pressure and an uninterrupted flow of liquid at the nozzle of hand spray pumps. The device consists of a separate chamber and a plunger with attachments including a leather cup washer, open spring, and supports, the entire assembly sliding freely within the chamber. The action of the spring serves to maintain a constant flow at the nozzle orifice by varying the capacity of the chamber in direct ratio to the pressure applied. The device is affixed between the spray pump and nozzle.

With the use of the equalizer, the variation in pressure at the nozzle orifice averages about 5 pounds with a maximum variation of about 10 pounds. Without the equalizer, the pressure varies from zero pounds to 75 pounds.

This particular attachment is probably more useful when the hand pumps are used for fire fighting purposes than for the application of spray to bushes.

Forest Service Standard Pump

In cooperation with the Forest Service, a hand pump was developed for fire fighting purposes which provided better control in directing the stream of water and also delivered the stream to a greater height.

The hand pump as designed has a stationary plunger and is operated by oscillating the barrel on the plunger. A 2-way internal valve, operating on both strokes, maintains a continual pressure at the nozzle. The capcity of the pump is 35 per cent greater than that of the pumps now in use and tests showed that this pump raised a stream of water 10 per cent higher than any other model. The stationary plunger also made it possible to hold the stream of water issuing from the pump on one spot for any length of time desired. These features in the pump make it more satisfactory for fire fighting equipment than the other models. Three pumps of this type were made for experimental tests.

FIELD EQUIPMENT REPAIR AND MAINTENANCE

Field Maintenance

Boxes of extra parts are now supplied to all field operations enabling a man in the inaccessible areas to service his equipment without delay or confusion. A field repair shop is maintained at a central point and all broken equipment is sent there for repair.

Equipment Upkeep

At the close of the field season in 1931 all couplings were repaired, motors were overhauled, pumps were rebuilt or repaired, nozzles were made ready for field service, and every precaution was taken to avoid delays in the field next season. Pack boards were dismantled, the covers were washed, and the frames painted. Knapsack tanks were given an acid bath and then dried out for storage.

Factory Cooperation

Pack boards are now delivered in the field with all attachments added at the factory, and a rebuild job is not necessary after their receipt by the Division of Blister Rust Control.

Hand pumps are now factory equipped for Ribes spraying and field breakdowns have been reduced to a minimum.

STATEMENT OF COSTS*

Experimental

1.	Injection tools:		
	a. No. 1	$177.60	
	b. No. 2	134.55	
	c. Wrench	3.75	
	d. Valve control	17.65	
	e. Spring	1.25	$334.80
2.	Aluminum pack frames (12)	35.16	35.16
3.	Chipman chemical duster	12.50	12.50
4.	Hand pumps, No. 3 Type A:		
	a. Plungers	43.65	43.65
	Total		$426.11

Power Equipment

1.	Coupling repairs	18.00	18.00
2.	Trigger nozzles	9.45	9.45
3.	Motor and pump repair:		
	Type N	68.97	
	Ross No. 11	12.85	
	Ross No. 12	77.08	
	Ross, 2-cylinder	12.00	170.90
	Total		198.35

Salaries and Expenses

Salaries	$1,699.92	
Expenses	182.08	1,882.00
Grand Total		$2,506.46

PLANS FOR FUTURE WORK

1. Design and have made up a bulldozer blade for removing Ribes and brush from stream bottoms.

2. Adapt a power sprayer for soil drenching experiments in Ribes suppression studies.

*These costs are all included in the cost statement under Studies on Chemical Eradication Methods.

3. Construct a tool to assist in the hand eradication of Ribes.

4. Continue experiments with dusting apparatus.

5. Extend cooperation to the Forest Service on hand pump experiments.

6. Secure adequate field data on spray pump pressure equalizer.

RIBES ERADICATION ON NATIONAL FORESTS

By
Herman E. Swanson, Agent
Neal D. Nelson, Agent
Frank O. Walters, Agent

INTRODUCTION

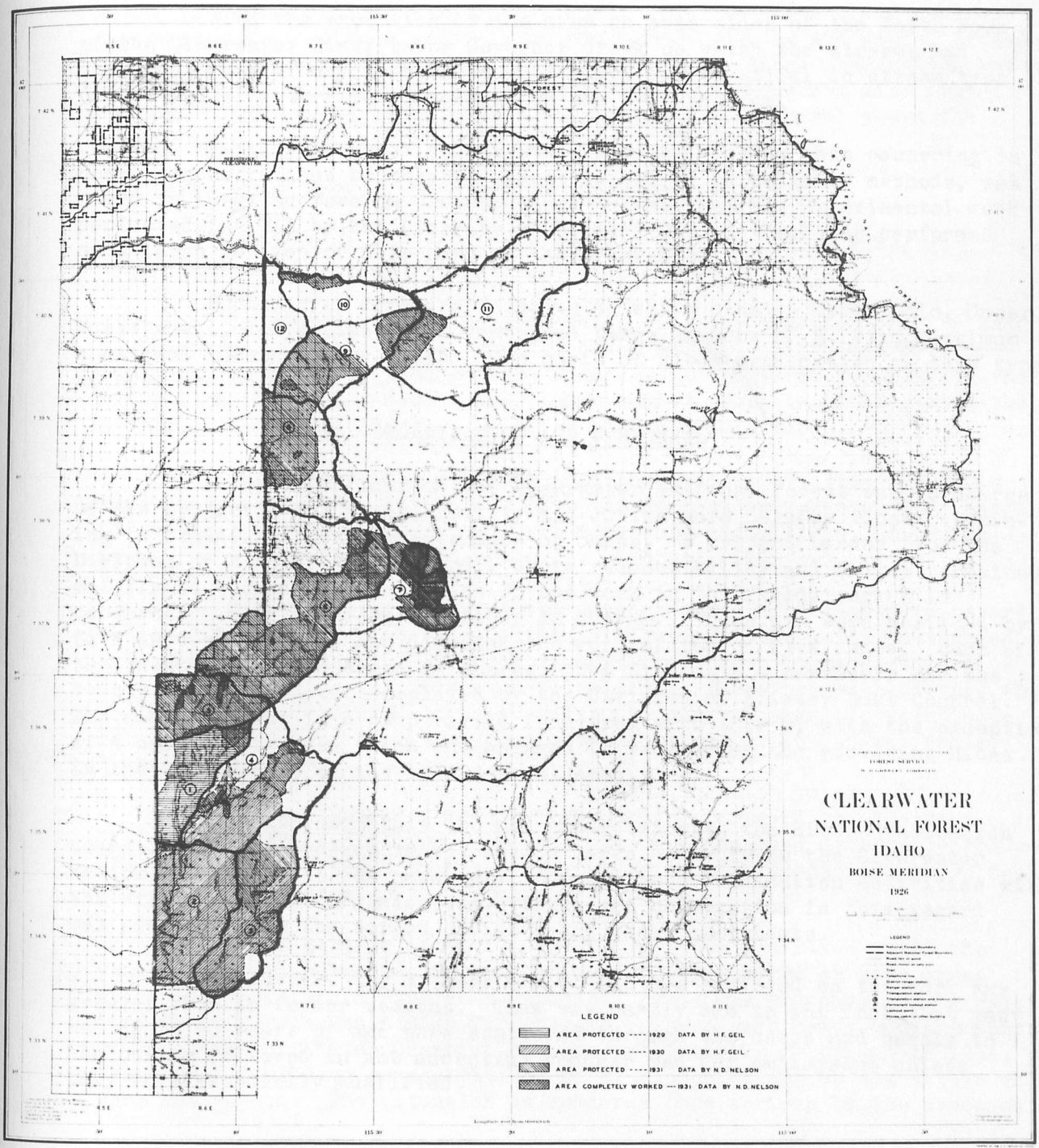
Ribes eradication for the control of white pine blister rust on national forests was begun by the Forest Service during the 1930 field season. Appropriations were sufficient to permit a large-scale operation during 1931, which marked the beginning of a ten-year program outlined to give protection to the major portion of white pine stands on national forests of northern Idaho and western Montana. The ten-year program provides for the eradication of Ribes from approximately 1,293,000 acres at an estimated cost of $3,377,000.

LOCATION AND DESCRIPTION OF AREA

For administrative reasons the 1931 program was concentrated on the Clearwater National Forest. It was believed that the work could be more easily organized when confined to a single forest. The purpose was to take up the work where it was left off during the previous season and to proceed northward through the white pine belt along the western side of the forest. The results of the work on the Clearwater National Forest are presented on the basis of eleven working units. A progress map shows the exact location of the control work on these units.

In regard to a description of the areas, Tables No. 2, 3, and 4, in setting forth the results of the work, show to a certain extent the conditions encountered on the various units, chiefly as to the number of acres worked in each type, the number of Ribes pulled, and the amount of chemical applied.

Although the number of Ribes is the most important factor influencing costs of eradication, brush conditions and slope add to the difficulty of working an area, and affect costs accordingly. In general, areas worked during 1931 which had a considerable number of Ribes were heavily covered with other brush. This was especially the case on reproduction areas. The great number of down logs on these areas also contributed to the difficulty of working. Although the country in general is very steep, there were only a few instances where this represented a serious problem.



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With the exception of the area on both sides of the North Fork of the Clearwater River below Governor Creek on which the streams had very few Ribes of any species, R. petiolare was plentiful in stream type over the entire territory included in the 1931 program.

R. inerme, which represents a special problem when occurring in heavy concentrations because it cannot be killed by ordinary methods, was found in large numbers on Orogrande and Weitas creeks. Experimental work conducted in 1931 by the Division of Blister Rust Control was performed on a large portion of this area on the Orogrande.

Burned-over areas reproducing to white pine on Upper Lolo, Upper Musselshell, and Weitas units contained large numbers of R. viscosissimum scattered through heavy brush. The costs of Ribes eradication on this type of area are high.

ORGANIZATION AND PERSONNEL

A forest officer of the Clearwater National Forest was in charge of the project. His responsibility and duties were chiefly those pertaining to organization and maintenance of camps. A project leader from the Division of Blister rust Control, whose responsibility and duties pertained chiefly to technical supervision of the work in the field, worked in cooperation with the forest officer in charge. These men were assisted by five unit supervisors who directed the work of two to five camps. Each of the twenty camps had a man in charge. The five unit supervisors and the twenty camp bosses were employed by the Division of Blister Rust Control. The number of men in a camp varied from twenty to thirty, with the exception of a camp of five men which was engaged in respraying the surviving Ribes in the stream type on the 1930 control area.

With approximately 450 men connected with the Ribes eradication operations, this project represented a large activity on the Clearwater National Forest. It was necessary to coordinate eradication activities with the existing forest organization. Excellent cooperation in this regard was received from the forest officers and their assistants.

In general, the average age of the men employed on the work was greater than in former seasons. This was partly due to the fact that many men 30 to 40 years of age were scattered through the camps and partly to the policy followed in not accepting younger men for employment unless they were especially qualified.

The results of this policy were generally satisfactory. For the most part the older men were natives of the region, either of the farmer class or former employees in forest work. In some cases older men, who had previous experience supervising the work of men in the woods, proved more satisfactory than younger men experienced in Ribes eradication but with no experience in handling large crews. The older men also proved very satisfactory as straw bosses and laborers. In normal years the supply of this type of labor is relatively limited.

POLICY DETERMINING AREAS TO BE TREATED

The policy regarding the type of areas on which Ribes should be eradicated involves several general considerations.

In reproduction stands of white pine the question of fire hazard is important. Single burns, chiefly those of 1919 origin and some of 1910 origin, are still a high fire hazard. Expenditures for blister rust control on such areas were deemed inadvisable. This is in line with the policy of the Forest Service in not planting single burns.

The number of white pine seedlings in reproduction stands is another important consideration. For the present only those areas having 200 white pine seedlings or more per acre were included in the control area.

A broad interpretation was given to the factors of fire hazard and amount of white pine reproduction present in determining whether an area should be treated, In order to gain protection it is essential to keep the control areas in large solid blocks. Therefore small burns, which would have been excluded if they had constituted a large block in themselves, were worked when they were essentially a part of or surrounded by areas which were treated.

Another general limitation was made in regard to elevation. Altitudinal limits of 4,500 to 5,000 feet were observed in both reproduction and timbered areas unless excellent white pine conditions above these elevations warranted going further.

Since certain points in the policy were not fixed until the season was well advanced, work had already been started on some areas which otherwise would have been excluded. This was the case on the Weitas area which represents a high fire hazard. There were heavy concentrations of R. inerme on Weitas Creek which were not entirely destroyed in 1931. There are also heavy concentrations of R. viscosissimum on the slopes which were not worked. The situation is rendered more serious by the presence of

blister rust on Hemlock Creek. The extent and intensity of this infection were not fully determined in 1931. To complete the protection of this area will require about the equivalent of the amount of work already performed there.

The following general method of Ribes eradication was followed on the areas which were to be given protection.

All stream type within the area was covered. R. petiolare was eradicated to a distance of 1/2 mile or more beyond the boundaries of the control area, the distance depending upon the conditions of the area and the number of R. petiolare present.

On upland areas only the heavy concentrations of Ribes were eradicated. This for the most part involved the working of reproduction areas.

With respect to the type of Ribes eradication provided for under this policy, it must be recognized that only a degree of partial protection is given to the areas. As a delay measure against blister rust, the work represents the first step in a control program. In order to give the area adequate protection it will be necessary in the near future to start follow-up or reeradication operations. Unworked blocks within the control area have up to 100 Ribes per acre. In some cases the ridges above 4,500 feet and 5,000 feet elevation have heavy Ribes concentrations. In case of a sudden spread and intensification of the rust in some localities, it may be necessary to modify the policy followed in 1931 and start a more thorough and intensive campaign of Ribes eradication on those areas.

The general Ribes eradication plan followed in regard to stream type and upland areas served to reduce substantially the Ribes live stem over the entire territory and to complete all high cost work. This leaves the entire territory in a satisfactory condition for reeradication operations in that all areas can be covered at a nominal cost per acre. Since no initial job of Ribes eradication is expected to give complete and permanent protection, this follow-up work must be done at periods of a few years until the Ribes live stem on the area is reduced to a satisfactory minimum. It was with this plan in view that only the heavy Ribes concentrations on the uplands were worked and that all other areas having Ribes would be covered at the time when reeradication was started.

STATEMENT OF EXPENDITURES FOR BLISTER RUST CONTROL ON NATIONAL FORESTS
1931

Forest Service	$136,940.41
Division of Blister Rust Control	15,508.87
Total expenditures	$152,449.28

Expenditures charged against 1931 operation on Clearwater National Forest:

Forest Service:

Total expenditures		$136,940.41
Less:		
Non-depreciated equipment	$8,161.72	
Chemical sent to Haugen, Montana	143.52	8,305.24
Total Forest Service charges		$128,635.17

Division of Blister Rust Control:

Total expenditures		$15,508.87
Less:		
Cost of preeradication survey for 1932 operations:		
St. Joe National Forest	$881.14	
Clearwater National Forest	1,500.13	2,381.27
Total Division of Blister Rust Control charges		$13,127.60
Total cost of 1931 blister rust control operations on Clearwater National Forest		$141,762.77

TABLE NO. 1

STATEMENT OF COST OF BLISTER RUST CONTROL OPERATION ON CLEARWATER NATIONAL FOREST, 1931

Item of Cost		Cost	
		Per Item	Total
Salaries and Wages	Supervisors	$9,024.77	
	Temporary laborers and field men	72,771.23	$81,796.00
Subsistence	Wages of cooks and flunkies	9,537.27	
	Cost of food	21,757.83	
	Transportation of food	8,489.13	
	Annual rental on subsistence equipment	746.83	
	Transportation of subsistence equipment	1,697.83	42,228.89
General Equipment	Annual rental	2,240.50	
	Repairs	418.10	
	Transportation	3,395.65	6,054.25
Chemical Equipment	Annual rental	1,073.70	
	Repairs	163.00	
	Transportation	848.91	2,085.61
Miscellaneous	Supplies	774.39	
	Expenses	220.85	
	Twine	560.47	
	Operation of cars by supervisors	270.00	1,825.71
Chemical	Cost	4,349.56	
	Transportation	3,422.75	7,772.31
Total cost of 1931 operation on Clearwater National Forest			$141,762.77

STATEMENT OF COMPOSITE COST PER EFFECTIVE MAN DAY

Total cost of operation		$141,762.77
Less chemical charges:		
Equipment and repairs	$2,085.61	
Chemicals	7,772.31	9,857.92
Cost less chemical charges		$131,904.85
Number of effective man days	18,556	
Cost per effective man day	$131,904.85/18,556	$7.11
Cost of chemical equipment and repairs	2,085.61	
Number of effective spraying man days	3,528	
Additional cost per spraying man day	$2,085.61/3,528	$.59
Cost per spraying man day $7.11 plus $.59		$7.70

Statement of chemical costs

Cost of chemical		$7,772.31
Number of gallons applied	78,075	
Cost per gallon		$.0995

METHODS AND EQUIPMENT

Standard methods and equipment were used throughout the operation. For the most part the 3-man crew was used for hand pulling work. The regular knapsack spraying equipment was used for the chemical work.

The following schedule for the treatment of R. petiolare with chemical was followed as closely as conditions and supply of chemical permitted:

1. Early season spraying up to July 15: sodium chlorate 0.5# per gallon of water.

2. Midseason spraying July 15 to August 15: Atlacide 1.0# per gallon of water.

3. Late season spraying, after August 15: sodium chlorate 1.0# per gallon of water.

In the treatment of R. inerme on Orogrande Creek application of spray was made to the aerial portion of the Ribes and the ground beneath. For this purpose power spraying equipment was loaned by the Division of Blister Rust Control to the Forest Service crews for about 20 days.

Experimental tests show that this method of treating R. inerme may be effective. For complete kill, a respray may be necessary during the following season.

Methods of Ribes eradication provide for a system of checking or reworking all areas both in stream type and on upland slopes where Ribes concentrations were heavy, by the camp boss and his assistant, to insure efficient work. Approximately 60 per cent to 70 per cent of the entire area was reworked for this purpose.

RESULTS OF RIBES ERADICATION OPERATIONS

The results of Ribes eradication operations are presented in the following tables:

Table No. 2, Ribes eradication by hand pulling methods on the Clearwater National Forest, 1931.

Table No. 3, Ribes eradication by spraying methods on the Clearwater National Forest, 1931.

Table No. 4, Ribes eradication clean-up work in stream type on 1930 control area on the Clearwater National Forest, 1931.

Table No. 5, Ribes eradication summary on the Clearwater National Forest, 1931.

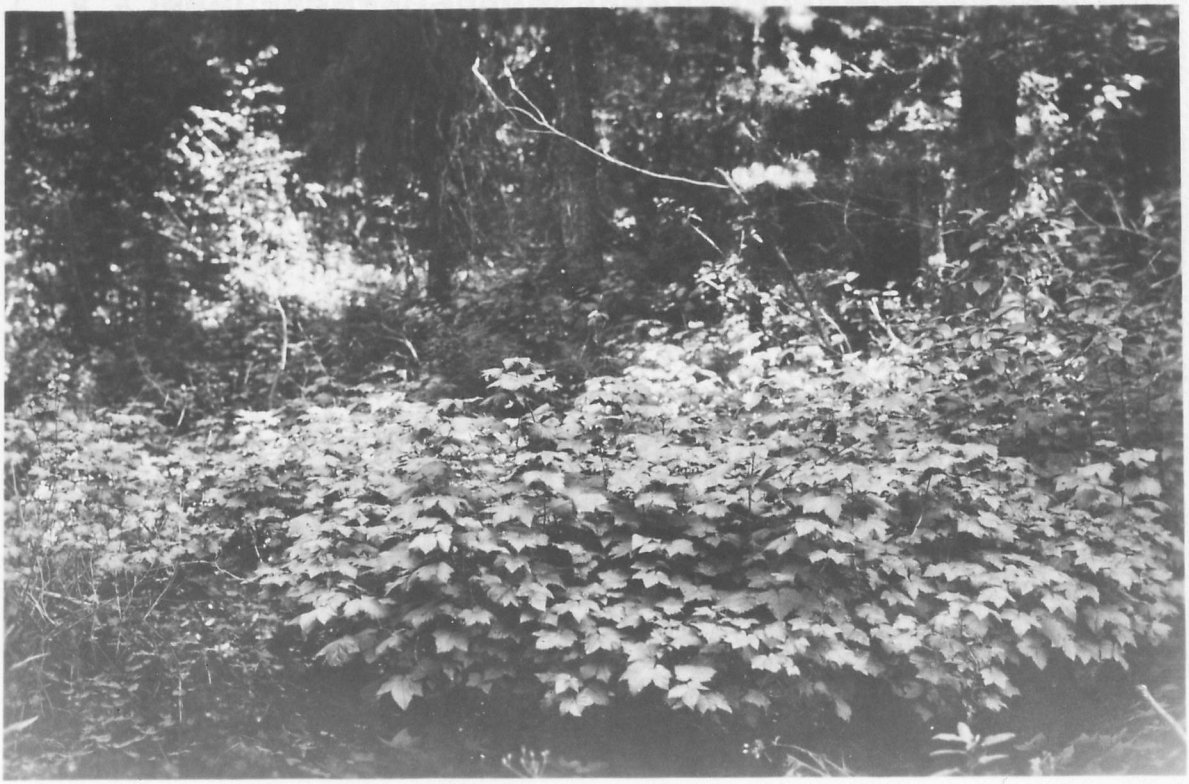
Table No. 6, Analysis of Ribes eradication by hand pulling methods on the Clearwater National Forest, 1931.

Table No. 7, Analysis of Ribes eradication by spraying methods on the Clearwater National Forest, 1931.

In considering the cost per acre on the areas actually worked, it must be borne in mind that the general plan of Ribes eradication called for the treatment of only the upland areas having heavy Ribes concentrations. Obviously the per acre costs on these areas are much greater than for work which would include areas having light as well as the heavy Ribes concentrations. When reeradication operations are started, the unworked areas, which had few Ribes, will be covered at a nominal cost, along with the reworking of the other areas.



W. 8-0. Stream type along Orogrande Creek. Clearwater National Forest.



W. 746. R. petiolare growing in brushy stream type.

TABLE NO. 2

RIBES ERADICATION BY HAND PULLING METHODS ON THE CLEARWATER NATIONAL FOREST, 1931

Working Unit Number	Type	Acres	Man Days	Number of Ribes Pulled					Total Cost	Per Acre Basis		
				R. lacustre	R. viscosissimum	R. petiolare	R. inerme	Total Ribes		Man Days	Ribes	Cost
	Stream	82	107	17,585	9,657	854	-	28,096	$760.61	1.30	342	$9.24
	Open reproduction	625	972	92,161	488,727	662	-	581,550	6,909.46	1.55	930	11.09
	Open mature	5	3	704	95	-	-	799	21.33	.60	160	4.26
1	All Types	712	1,082	110,450	498,479	1,516	-	610,445	$7,691.40	1.52	857	$10.80
	Stream	1,379	621	130,417	18,041	2,083	-	150,541	4,414.38	.45	109	3.20
	Open reproduction	8	17	810	3,259	-	-	4,069	120.84	2.12	509	15.07
	Open mature	109	59	1,999	11,639	24	-	13,662	419.40	.54	125	3.84
3	All Types	1,496	697	133,226	32,939	2,107	-	168,272	$4,954.63	.47	112	$3.34
	Stream	1,125	1,331	266,601	11,544	30,460	144,153	452,758	9,461.41	1.18	402	8.39
	Open reproduction	160	501	8,042	240,094	62	24	248,222	3,561.36	3.13	1,551	22.25
	Open mature	156	164	50,571	278	2,105	44,784	97,738	1,165.79	1.05	626	7.46
4	All Types	1,441	1,996	325,214	251,916	32,627	188,961	798,718	$14,188.56	1.38	554	$9.81
	Stream	1,038	729	223,336	7,902	11,919	43	243,200	5,182.10	.70	234	4.98
	Open reproduction	400	345	46,895	40,908	18	27	87,848	2,452.43	.86	217	6.11
	Open mature	14	14	2,544	855	174	-	3,573	99.52	1.00	255	7.11
5	All Types	1,452	1,088	272,775	49,665	12,111	70	334,621	$7,734.05	.75	231	5.33
	Stream	2,645	3,215	867,948	11,824	48,214	16,861	944,847	22,853.83	1.22	357	8.67
	Open reproduction	201	293	61,260	10,630	848	427	73,165	2,082.79	1.46	364	10.38
	Open mature	313	343	24,006	32,177	45	1,674	57,902	2,438.21	1.10	185	7.82
	Open pole	186	167	40,061	396	-	-	40,457	1,187.12	.89	217	6.33
6	All Types	3,345	4,018	993,275	55,027	49,107	18,962	1,116,371	$28,561.95	1.20	334	$8.53
	Stream	253	189	19,466	15,783	8,644	6,218	50,111	1,343.51	.75	198	5.33
	Open reproduction	2,662	1,494	52,807	940,644	6,637	8,555	1,008,643	10,620.10	.56	379	3.98
	Open mature	677	392	14,725	134,733	355	1,184	150,997	2,786.53	.58	223	4.12
7	All Types	3,592	2,075	86,998	1,091,160	15,636	15,957	1,209,751	$14,750.14	.57	337	$4.05
	Stream	1,080	1,403	451,008	13,803	5,400	-	470,211	9,973.23	1.28	433	9.10
	Open reproduction	127	154	17,488	30,621	-	-	48,109	1,094.71	1.24	388	8.81
	Open mature	276	419	139,439	631	26	-	140,096	2,978.46	1.53	513	10.88
8	All Types	1,483	1,976	607,935	45,055	5,426	-	658,416	$14,046.40	1.34	444	$9.53
	Stream	1,061	1,374	438,868	31,479	3,603	2,323	476,273	9,767.08	1.29	448	9.17
	Open reproduction	197	220	5,892	64,186	50	29	70,157	1,563.87	1.12	356	7.96
	Open mature	32	19	3,555	962	12	-	4,529	135.06	.59	141	4.19
9	All Types	1,290	1,613	448,315	96,627	3,665	2,352	550,959	$11,466.01	1.25	427	$8.88
10	Stream	34	12	1,536	32	116	-	1,684	85.30	.35	49	2.48
	Stream	455	456	8,833	12,661	11	17	21,522	3,241.47	1.00	47	7.11
	Open reproduction	26	15	2	691	1	-	694	106.63	.58	27	4.12
11	All Types	481	471	8,835	13,352	12	17	22,216	$3,348.10	.98	46	$6.97
	Stream	9,152	9,437	2,425,598	132,726	111,304	169,615	2,839,243	67,082.92	1.03	310	7.32
	Open reproduction	4,406	4,011	285,357	1,819,760	8,278	9,062	2,122,457	28,512.19	.91	482	6.47
	Open mature	1,582	1,413	237,543	181,370	2,741	47,642	469,296	10,044.31	.89	296	6.33
All	Open pole	186	167	40,061	396	-	-	40,457	1,187.12	.90	217	6.40
Units	All Types	15,326	15,028	2,988,559	2,134,252	122,323	226,319	5,471,453	$106,826.54	.98	357	$6.97

TABLE NO. 3

RIBES ERADICATION BY SPRAYING METHODS ON THE CLEARWATER NATIONAL FOREST, 1931

Working Unit No.	Method	Acres	Man Days	Gallons of Spray	Total Cost	Per Acre Basis		
						Man Days	Gallons of Spray	Cost
1	Knapsack	61	43	810	$411.70	.70	13.2	$6.75
3	"	261	175	4,334	1,778.87	.67	16.6	6.82
4	"	192	144	2,899	1,397.32	.75	15.1	7.28
5	"	402	387	7,272	3,703.66	.96	18.1	9.21
6	"	782	1,229	29,012	12,350.88	1.58	37.0	15.79
6	Power	28	132	5,628	1,576.60	4.71	201.0	56.31
7	Knapsack	169	483	11,592	4,872.86	2.85	68.6	28.83
8	"	119	316	7,301	3,159.87	2.65	61.3	26.55
9	"	167	319	6,964	3,149.42	1.91	41.7	18.86
All Units		2,181	3,228	75,812	$32,401.18	1.48	34.7	$14.86

TABLE NO. 4

RIBES ERADICATION CLEAN-UP WORK IN STREAM TYPE ON THE 1930 CONTROL AREA ON THE CLEARWATER NATIONAL FOREST, 1931

Working Unit No.	Method	Acres	Man Days	Gallons Spray	Total Cost	Per Acre Basis		
						Man Days	Gallons	Cost
1	Knapsack	100	41	340	$349.50	.41	3.4	$3.49
2	"	395	114	986	975.87	.29	2.5	2.47
3	"	476	145	937	1,209.68	.30	1.9	2.54
All Units	Knapsacks	971	300	2,263	$2,535.05	.31	2.3	$2.61

TABLE NO. 5

RIBES ERADICATION SUMMARY ON THE CLEARWATER NATIONAL FOREST, 1931
(Summary includes Tables No. 2 and 3)*

Working Unit Number	Number Acres Worked			Number Acres Partially Protected	Man Days	Number Ribes Pulled	Gallons Spray Used	Total Cost	Cost Per Acre	
	Stream Type	Upland	Total						Stream	Upland
1	82	630	712	1,250	1,226	610,445	810	$8,103.10	$14.29	$11.00
3	1,379	117	1,496	3,700	872	168,272	4,334	6,733.50	4.49	4.62
4	1,125	316	1,441	7,550	2,039	798,718	2,889	15,585.88	9.65	14.94
5	1,038	414	1,452	5,175	1,475	334,621	7,272	11,437.71	8.56	6.16
6	2,645	700	3,345	21,880	5,379	1,116.371	34,740	42,489.43	13.90	8.15
7	253	3,339	3,592	6,910	2,558	1,209,751	11,692	19,623.00	24.57	4.01
8	1,080	403	1,483	8,050	2,292	658,416	7,301	17,206.27	12.16	10.10
9	1,061	229	1,290	8,340	1,932	550,959	6,964	14,615.43	12.17	7.42
10	34	-	34	790	12	1,684	-	85.30	2.51	-
11	455	26	481	6,720	471	22,216	-	3,348.10	7.12	4.10
All Units	9,152	6,174	15,326	70,365	18,256	5,471,453	76,002	$139,227.72	$10.87	$6.44

*Does not include respraying work on 1930 control area presented in Table No. 4.

1. Completion of the unfinished areas on the 1931 control area will make it possible to give an average per acre cost for protection over the entire area.
2. The costs per acre for upland work are high due to the fact that only the heaviest Ribes concentrations were worked.

TABLE NO. 6

ANALYSIS OF RIBES ERADICATION BY HAND PULLING METHODS ON THE CLEARWATER NATIONAL FOREST, 1931

Type	Ribes Per Acre Class	Acres Worked	Ribes Pulled Per Acre					Man Days Per Acre
			R. lac.	R. vis.	R. pet.	R. inerme	Total	
Stream	0-25	843.1	8.1	2.3	.41	.56	11.37	.41
	26-50	533.3	25.7	8.3	3.10	.62	37.72	.54
	51-100	864.6	64.7	9.9	4.20	1.90	80.70	.63
	101-200	1,909.0	121.2	12.5	5.10	4.40	143.20	.75
	201-400	2,510.0	252.7	15.3	10.16	10.00	288.15	1.07
	401-800	1,679.5	487.2	18.7	13.10	35.50	554.50	1.53
	801-1600	639.0	892.7	32.9	56.60	83.30	1,065.50	2.18
	1601-3200	63.6	1,630.7	13.2	14.50	98.50	1,756.90	3.65
	3201 and up	3.7	2,930.8	-	422.70	301.90	3,655.40	4.48
	All Classes	9,045.8	270.3	14.4	12.14	17.30	314.10	1.05
Open Reproduction	0-25	277.0	0.4	8.4	-	.05	8.85	.09
	26-50	132.2	3.5	38.0	.01	.02	41.53	.28
	51-100	685.7	4.9	68.7	.20	1.40	75.20	.38
	101-200	934.6	28.1	112.6	.70	1.90	143.30	.49
	201-400	1,024.8	72.1	218.1	3.70	4.70	298.60	.81
	401-800	732.4	131.8	480.5	2.90	6.40	621.60	1.24
	801-1600	397.3	150.9	951.3	3.10	1.90	1,107.20	1.80
	1601-3200	194.9	109.1	2,049.2	2.30	1.20	2,161.80	2.33
	3201 and up	63.5	72.3	4,819.2	.30	.01	4,891.81	5.15
	All classes	4,442.4	64.5	409.4	1.90	3.00	478.80	.91
Open Mature	0-25	106.6	6.6	6.4	.70	.07	13.77	.19
	26-50	181.3	10.3	27.9	.07	2.40	40.67	.24
	51-100	173.5	21.2	55.8	1.20	1.20	79.40	.51
	101-200	513.2	58.2	109.8	1.40	5.00	174.40	1.05
	201-400	333.5	149.1	122.5	.40	12.00	284.00	.76
	401-800	192.2	325.4	160.1	.90	68.10	554.50	1.22
	801-1600	99.3	761.5	44.9	6.50	266.10	1,079.00	2.04
	1601-3200	22.1	712.1	1,087.1	8.40	318.50	2,126.10	2.71
	3201 and up	2.5	1,546.6	1,484.4	44.40	880.80	3,956.20	3.40
	All classes	1,624.2	150.1	108.1	2.40	34.50	295.10	.89
Open Pole	0-25	46.9	14.7	.44	-	-	15.14	.13
	26-50	4.0	44.5	-	-	-	44.50	.37
	51-100	7.3	75.3	-	-	-	75.30	1.10
	101-200	64.2	169.6	.36	-	-	169.96	.85
	201-400	44.9	272.0	5.40	-	-	277.40	1.00
	401-800	3.9	533.1	21.80	35.4	-	590.30	1.41
	801-1600	13.8	898.7	.07	-	-	898.77	3.20
	1601-3200	.6	1,773.3	48.30	15.0	-	1,836.60	4.16
	All classes	185.6	215.8	2.10	.8	-	218.70	.90

TABLE NO. 7

ANALYSIS OF RIBES ERADICATION BY SPRAYING METHODS ON THE CLEARWATER NATIONAL FOREST, 1931

Method	Eradication Class Gallons Per Acre	Acres Worked	Gallons Per Acre	Man Days Per Acre
First Treatment	0-5	227.6	3.27	.33
	6-10	305.0	8.53	.89
	11-20	483.6	13.23	.76
	21-40	569.3	28.78	1.31
	41-80	322.7	55.44	2.22
	81-160	137.1	121.21	4.29
	161-320	75.0	167.73	5.32
	321 and up	7.0	386.34	11.71
	All Classes	2,127.3	35.68	1.52
Respray	0-5	979.6	2.11	.29
	6-10	98.0	7.36	.44
	11-20	46.2	15.45	.99
	21-40	36.7	27.88	1.46
	41-80	4.8	61.25	1.88
	81-160	3.2	100.62	2.50
	All Classes	1,168.5	4.40	.37

DISCUSSION OF RESULTS

On account of the interruption in the work occasioned by a serious fire situation and the underestimates as to the amount of work involved due to insufficient knowledge of conditions on some areas, many camp areas were left unfinished.

The type of checking done by the camp boss or his men on those areas on which the Ribes were removed served to make the job very efficient. Data show that in most cases not more than 50 feet of Ribes live stem were left per acre. On account of the resprouting which takes place on sprayed areas and on missed crowns and roots on other areas this check cannot be taken as the final measure of efficiency for the area.

USE OF BLISTER RUST CREWS ON FIRES

Blister rust camps were distributed over a wide area and their proximity to several bad fire regions made them a valuable auxiliary to the

regular fire control force. Each camp was equipped with two smoke-chaser packs and two capable men in the eradication crew were designated to act as smoke chasers in case of call.

Ribes eradication work and fire fighting represent two entirely different activities with separate funds allotted to carry on each of them. To the extent that blister rust crews take over fire duties, costs of Ribes eradication are affected. Interruptions occasioned by fires interfere with the most satisfactory and economical progress of the work. Even though the actual time that blister rust crews are away from their work is charged to fire, there are certain losses which are not equalized. The reduction in efficiency on the part of the men and the disrupting influence on the work resulting from fire duty are important considerations. Overhead and equipment charges are fixed and each effective man day spent on Ribes eradication reduces the proportion of these charges against the control area. This is also the case in regard to costs of training the men. Since the period of active work is limited it is essential that as many man days as possible be spent productively.

It is recognized that fire emergency requires the immediate use of all available men. It is therefore both necessary and desirable that blister rust crews serve as a part of the fire control force. To meet this situation a suitable policy regarding the cooperation between the fire organization and blister rust control units on each national forest should be promulgated by the proper forest officer.

This policy should consider the following:

1. The fire duty that is to be assumed by blister rust crews should be prescribed and the ways and means for carrying out this duty to its full requirements should be properly provided for.

2. The duties as prescribed should be so definite as to leave no question in the minds of either the fire chief or the blister rust control chief regarding authority over the men at all times. Since the blister rust crews are responsible to their chief during the greater part of the season, no other person on the forest should at any time exercise authority over these men except through him.

3. Ways and means should be provided for eliminating the necessity of holding men in camp awaiting possible call to fire. The records show that all men in certain blister rust camps have been ordered to remain in camp for periods up to several days for possible call to fire. This practice is wasteful of time and demoralizing to the men. The necessity of this sort of thing is questionable, since experience has shown that men can be called from the field and sent to a fire before the arrival of tools and

equipment. It is possible for the camp boss to submit a statement at suitable intervals to the fire control organization indicating the number of hours required to call in and prepare varying numbers of his men for fire duty. It is not too much to expect the fire control unit to file this information at headquarters. This would give the proper forest officer a ready reference for judging when to call men for blister rust duty in light of the time required to arrange for transportation facilities and to supply necessary tools and equipment for these men.

In case of bad fire conditions one or more runners should be paid on fire time and held at the camp to call in the men as needed. If necessary a camp boss may occasionally locate his crews where they can be quickly reached either by assigning them to work on areas near camp or assigning all crews to the same block unit.

4. In so far as possible blister rust crews should be used for fighting fire only in the case of emergency. They should be released when the emergency is passed or when they can be replaced by other men.

5. It is advisable that a conference be held between officials of the Forest Service and the Division of Blister Rust Control to consider and adopt a definite policy in regard to these matters. Ganeralities are possibly of less value than certain specific details which are required to definitely fix the essential points necessary to the orderly and effective operation of a plan on the ground.

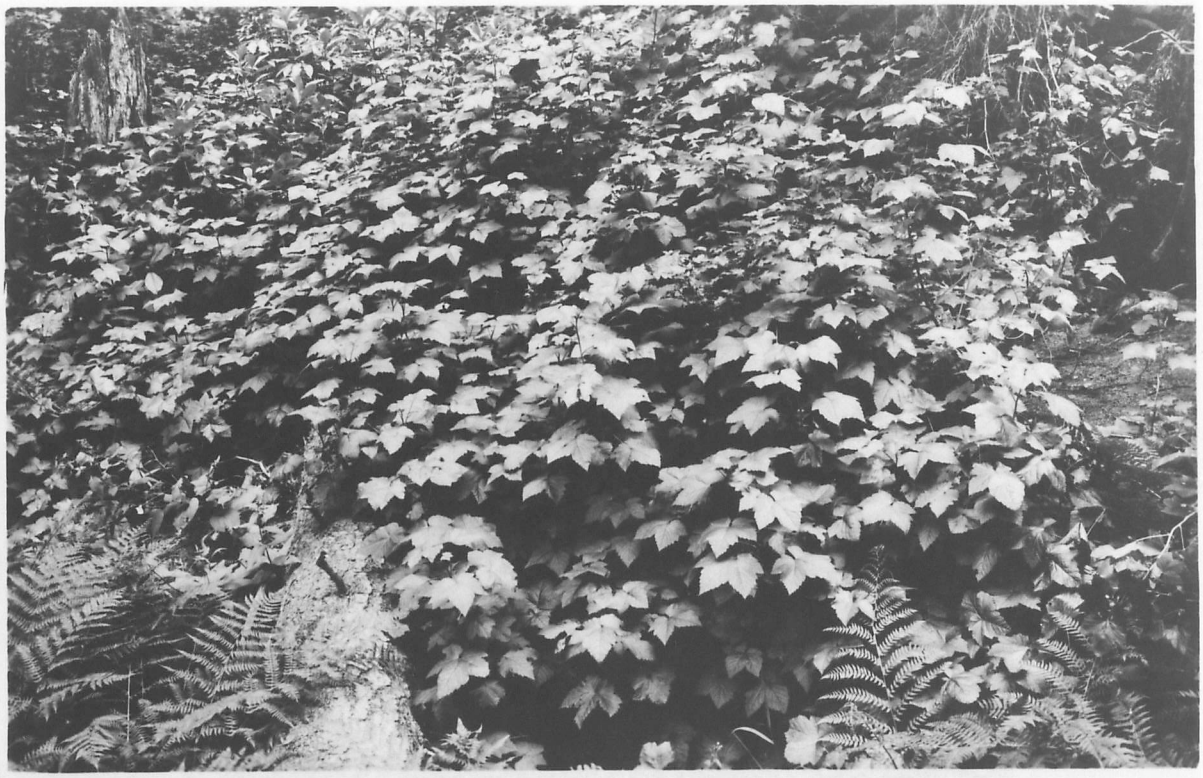
CONCLUSION

With respect to the Ribes eradication policy being followed, it seems adviaable to consider plans for reeradication on all areas. This operation would include the working of those areas having scattered Ribes which were not worked under the plan followed in 1931. This work should be started after the initial job on the forest is completed on a small scale sufficient to rework the control area within a period of a few years. By proper planning and distribution of crews on this type of work, these men can be made a valuable auxiliary to the fire control forces on the forest.

As discussed in the body of the report, a definite understanding should be had as to the relation of blister rust crews to fire control. Through close cooperation between forest officers and men in charge of the camps, it is believed that the crews can be made a valuable auxiliary to the fire control forces without serious interruption in the work.

In regard to the selection of personnel, it seems advisable to follow the policy of employeing older men and in so far as possible men who live in the immediate locality. These characteristics, however, must be considered in the light of other qualifications, as woods experience and physical fitness.

In preparation for the 1932 blister rust control operations on the Clearwater National Forest, a preeradication survey was made of the major portion of the white pine stands on the forest.



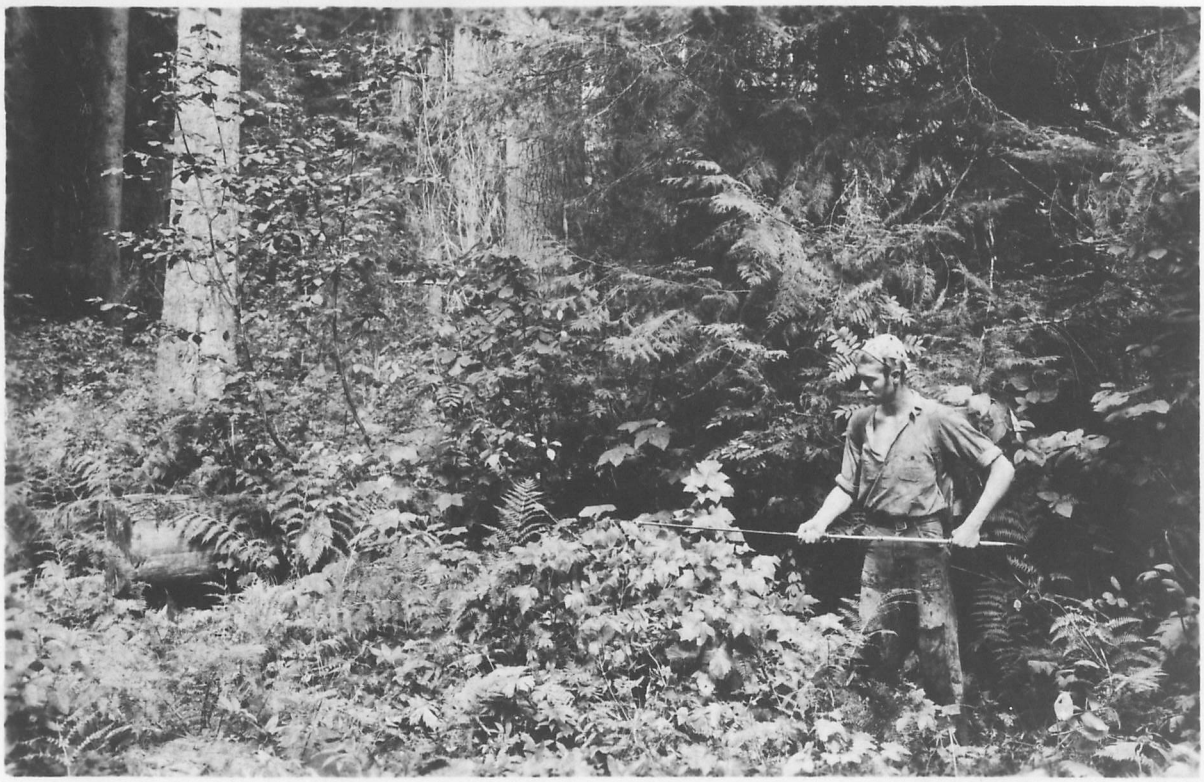
W. 961. R. petiolare as it grows in dense concentrations along Big Breakfast Creek on the Clearwater Timber Protective Association. This clump covered an area of 30 feet square. Some R. lacustre is mixed with it.



W. 961-1. The same clump of R. petiolare as shown in the above picture one day after being sprayed with a 10 per cent solution of $NaClO_3$.



W. 914. Dense masses of fibrous "water roots" of R. petiolare. The function of these roots is not definitely known but they seem to have the faculty of keeping the plant alive after the live stem above water has been repeatedly killed by successive sprayings with sodium chlorate or Atlacide. This condition is general with R. petiolare bushes growing in water and presents a difficult problem.



W. 935. Crewman using a knapsack sprayer to spray R. petiolare with a 10 per cent solution of sodium chlorate in swampy stream type on Silver Creek on the Clearwater Timber Protective Association. Dense mature white pine is 95 per cent pure along this stream.

COOPERATIVE LOCAL CONTROL
CLEARWATER TIMBER PROTECTIVE ASSOCIATION

By
B. A. Anderson,
Junior Forester

INTRODUCTION

During the 1931 season blister rust control operations were continued on association lands along the same general lines as during 1929 and 1930. These operations consisted of the eradication of Ribes from the stream type within white pine areas. During 1931 a total of $60,000, an increase of $30,000 over 1930, was available for local control of white pine blister rust on the Clearwater Timber Protective Association.

LOCATION AND DESCRIPTION OF AREA

TABLE NO. 1

DRAINAGES IN WHICH THE INITIAL ERADICATION OF STREAM TYPE RIBES WAS PERFORMED IN 1931

Drainage	Location (Boise Meridien)
Rhodes Creek	T. 36 N., R. 5 E.; T.37 N.,R.6 E.
Orofino Creek	T. 36 N., R. 5 E.
Shanghai Creek	T. 37 N., R. 6 E.
Canal Gulch	T. 37 N., R. 5 E
Big Breakfast Creek	T. 37 and 28 N., R. 6 E.
Oro Grande Creek	T. 37 N., R. 6 E.
Quartz Creek	T. 37 N., R. 5 E.
Little Beaver Creek	T. 37 N., R. 5 E.
Trail Creek	T. 37 N., R. 5 E.
Silver Creek	T. 39 N., R. 4 and 5 E.
East Fork Beaver Creek	T. 39 N., R. 6 E.

Heavy patches of Ribes inerme occurred only on Rhodes and Orofino creeks. With the exception of the East Fork of Beaver Creek, dense masses of R. petiolare occurred on every drainage.

METHODS AND EQUIPMENT

Camps were so located that they could be reached by truck at the start of the field season and were moved into the back country when the first areas were finished.

One and one-half-ton and one-half ton Chevrolet trucks were used to transport equipment, food and chemical. In addition to the trucks a 9-mule pack string was used after July 22.

A spray of either sodium chlorate or Atlacide was applied to R. petiolare bushes by the knapsack spraying method. Bushes of all other Ribes species were hand pulled.

The following is the spraying schedule adhered to as closely as possible:

Until July 15 - ½# $NaClO_3$ to a gallon of spray.
July 15 to August 15 - 1# Atlacide to a gallon of spray.
After August 15 - .9# $NaClO_3$ or 1.4# Atlacide to a gallon of spray.
Animal glue used for a spreader.
No spraying after August 31.

About 160 men divided into 20-man camps were employed for an average of three months. A part-time flunky was used in each camp. Three men constituted a hand-pulling crew and 4 men a knapsack spraying unit.

All staple foodstuffs were purchased on bid from the Clearwater Timber Company who also furnished warehouse space at Headquarters, Idaho.

WORK PERFORMED AND RESULTS

Table No. 2 is a summary by Ribes classes of eradication data by hand pulling methods.

TABLE NO. 2

SUMMARY OF DATA FOR RIBES ERADICATION PERFORMED BY HAND PULLING METHODS

*Ribes Class	Man Days	Acres	Ribes Pulled Per Acre						Man Days Per Acre
			R. lac.	R. pet.	R. vis.	R. iner.	R. irrig.	Total	
0-25	208.94	902.10	14.02	.34	.92	.78		16.06	.23
26-50	274.75	834.60	39.36	.49	1.17	.44	.01	41.47	.33
51-100	600.23	1,395.57	69.25	.81	2.84	2.19		75.09	.43
101-200	1,084.67	1,848.66	141.49	1.41	2.46	1.76	.05	147.17	.59
201-400	1,292.04	1,486.59	263.23	2.08	3.21	11.88	.06	280.46	.87
401-800	890.29	673.87	533.28	4.70	7.38	12.04	.01	557.41	1.32
801-1600	302.85	155.72	849.10	5.11	7.73	96.25	.02	958.21	1.95
1601-3200	47.30	16.33	1,825.66	.61	.12	.43		1,826.82	2.90
3201-Over	1.50	.20	1,630.00			2,140.00		3,770.00	7.50
Totals or Averages	4,702.57	7,313.64	180.04	1.57	2.91	6.64	.02	191.18	.64

*Ribes class designated by numbers per acre.

TABLE NO. 3

SUMMARY OF CHEMICAL ERADICATION DATA

Gallons Spray Per Acre	Man Days	Acres	Gallons	Man Days Per Acre	Gallons Per Man Day	Gallons Per Acre
0-5	68.09	273.20	767	.25	11.3	2.8
6-10	118.37	252.60	1,910	.47	16.1	7.6
11-20	173.40	210.70	3,255	.82	18.8	15.4
21-40	457.25	363.05	10,705	1.26	23.4	29.5
41-80	629.01	294.25	17,798	2.14	28.3	60.5
81-160	711.49	179.80	22,045	3.96	31.0	122.7
161-320	242.50	38.45	8,105	6.31	33.4	211.0
321-Over	86.50	6.20	2,660	13.95	30.8	429.0
Totals or Averages	2,486.61	*1,618.25	67,245	1.54	27.0	41.6

*This total acreage is included in the acreage on which the Ribes were hand pulled.

TABLE NO. 4

SUMMARY OF RIBES ERADICATION DATA BY HAND PULLING AND SPRAYING METHODS

Working Unit	Acreage: Stream Type	Acreage: Upland	Acreage: Partially Protected	Acreage: Completely Worked	Man Days	Number Ribes Pulled	Gallons Spray Used	Cost: Total	Cost: Per Acre
On Clearwater Timber Protective Association									
2	1,562.67	None	20,800	None	1,296.90	272,308	12,677	$9,636.58	$ .46
6	742.90	"	4,440	"	220.00	70,204		1,451.25	0.33
8	1,284.92	"	5,600	"	1,977.05	409,452	25,760	15,233.99	2.72
9	1,296.35	"	6,490	"	1,362.75	280,639	9,852	9,869.09	1.52
10	1,135.81	"	7,680	"	1,257.33	166,164	14,344	9,539.39	1.24
12	1,075.60	"	4,320	"	773.65	145,027	2,673	5,341.40	1.24
Totals or Averages	7,098.25		49,330		6,887.68	1,343,794	65,306	$51,071.70	$1.04
On Forest Service Lands									
Rhodes Creek	189.40	"	1,300	"	128.50	27,435	744	914.88	.70
Orofino Creek	153.25	"	1,900	"	173.00	27,064	1,195	1,250.08	.66
Totals or Averages	342.65		3,200		301.50	54,499	1,939	2,164.96	.68
Grand Totals or Averages	7,440.90		52,530		7,189.18	1,398,293	67,245	$53,236.66	$1.01

Several of the camps were unable to finish all the stream type acreage of the drainages they were working. The following is an estimate of the number of man days necessary to complete stream type eradication on those drainages, the acreage of which is included in the total area reported as partially protected:

1. Beaver (T. 37 N., R. 5 E.) and Trail creeks - spraying 216 man days.
2. Upper Breakfast Creek - hand pulling..... 72 " "
   Total..... 288 man days

Silver Creek has not been completed. There remains enough stream type to be eradicated of Ribes to keep and 18-man camp busy for about 8 weeks. The area represented by this block has not been included in the area reported as partially protected.

Reeradication operations were carried out on the South Fork of Reed's Creek above Calhoun Creek, the North Fork of Reed's Creek above the forks of Reed's Creek, and on Alder Creek above Parallel Creek. Initial eradication was done in 1929 on these streams.

Table No. 5 is a summary of the work done by the two crews on reeradication work.

TABLE NO. 5

SUMMARY OF REERADICATION OPERATIONS

Drainage	Man Days	Gallons Spray	Ribes Species Hand Pulled					
			R.lac.	R.pet.	R.iner.	R.vis.	Total	Cost
North Fork Reed's Creek	165.5	1,917	3,019	28		39	3,086	$1,278.64
South Fork Reed's Creek	251.0	1,574	8,722	834	30		9,586	1,835.03
Alder Creek	29.0	304	8		83		91	221.56
Totals	445.5	3,795	11,749	862	113	39	12,763	$3,335.23

TABLE NO. 6

CHRONOLOGICAL RECORD OF RIBES ERADICATION ON CLEARWATER TIMBER PROTECTIVE ASSOCIATION

On Clearwater Timber Protective Association Lands									
		Acreage						Per Cent White Pine Lands on C.T.P.A. Protected	
Year	Expenditures	Actually Worked	Partially Protected	Totally Protected	Effective Man Days	Number Ribes Pulled	Gallons Spray Applied	Totally Worked	Partially Protected
1929	$30,000.00	900.80	21,500	-	2,366.00	253,133	25,229	-	6.57
1930	30,000.00	3,054.95	61,000	-	3,320.72	630,824	18,123	-	18.65
1931	57,835.04	7,099.25	49,330	-	6,887.68	1,343,794	65,306	-	15.08
Totals and Averages	$117,835.04	11,055.00	131,830	-	12,574.40	2,227,751	108,658	-	40.30
*On Forest Service Lands									
1931	$2,164.96	342.65	3,200	-	301.50	54,499	1,939	-	
Totals and Averages	$120,000.00	11,397.65	135,030	-	12,875.90	2,282,250	110,597	-	

*There are several acres of white pine lands on the Clearwater National Forest which are located in the same drainages as certain working units of the Clearwater Timber Protective Association and can be most economically eradicated of Ribes by association crews. There are also considerable acreages of white pine lands located within the Clearwater National Forest boundaries which are owned by members of the Clearwater Timber Protective Association. Portions of the acreages within the forest boundaries can be most advantageously worked by Forest Service crews. The eradication work done on white pine lands of the Clearwater National Forest by camps on the Clearwater Timber Protective Association is summarized in the above table.

PREERADICATION SURVEY

At the end of the eradication season a preeradication survey was made on the drainages listed in the following table:

TABLE NO. 7

PREERADICATION STREAM TYPE SURVEY

Drainage	Time Needed to Work Area	Amount of Chemical Needed on Basis of 1.4# Atlacide to 1 Gal. Spray
Benton Creek Butte Creek Thompson Creek	2 10-man camps 2⅓ mos.	0.75 ton
Washington Creek	20-man camp 7 mos.	17.0 tons
Scofield Creek	20-man camp 3 mos.	8.5 "
Little Breakfast Creek	20-man camp 3 mos.	6.0 "
Crystal Creek	20-man camp 2 mos.	5.0 "
Silver Creek	20-man camp 3 mos.	8.0 "
Elk Creek	20-man camp 5 mos.	12.5 "
Upper Brown's Creek	2 10-man camps 3 mos.	7.5 "
Rainy Creek	20-man camp 3/4 mo.	0.5 "
Cow Creek	20-man camp 1½ mos.	1.0 "
Winter Creek	10-man camp 1½ mos.	0.4 "
Grasshopper Creek	10-man camp 1½ mos.	2.5 "
Total		69.65 "

The following is a statement of areas on which Ribes have been eradicated from stream type which were burned over by 1931 fires and the number of man days spent in controlling them by blister rust men:

Acreage burned on 1930 eradicated area... 285 acres, 24 man days
Acreage burned on 1931 eradicated area... 325.5 " 94 " "
Total man days on fire control..... 118 man days

STATEMENT AND ANALYSIS OF COSTS

TABLE NO. 8

STATEMENT OF COST OF OPERATION

Item of Expenditure		Cost	
		Per Item	Total
Salaries and Wages	Supervisors	$ 5,456.50	
	Temporary field men	27,981.15	$33,437.65
Subsistence	Wages, cooks and flunkies	3,213.79	
	Cost of food	9,671.45	
	Transportation of food	852.99	
	Annual rental on subsistence equipment	399.15	
	Transportation of subsistence equipment	153.84	14,291.22
General Equipment	Annual rental	1,116.06	
	Repairs	258.44	
	Transportation	396.00	1,770.50
Chemical Equipment	Annual rental	254.31	
	Transportation	90.00	
	Repairs	314.38	658.69
Miscellaneous	Supplies	176.29	
	Expenses	97.22	
	Twine	295.54	
	Operation of cars by supervisors	294.36	863.41
Chemical Charge	Cost	4,150.27	
	Transportation	1,400.15	5,550.42
	Grand Total	$56,571.89	$56,571.89

Composite cost per effective man day on hand pulling... $6.596.
Composite cost per effective man day on spraying..... $6.821.
Cost per gallons of spray..... $0.0781.

Total cost of subsistence $13,435.02.
Total number of meals served 39,703.
Average cost per meal $0.3384.

DISCUSSION AND ANALYSIS

A wider strip of territory was worked along streams during the 1931 season than in former years. Fourteen and one-half per cent of the area reported as partially protected was completely eradicated of Ribes. At the

present rate of progress it will take from one and one-half to two field seasons to complete the eradication of Ribes from the stream type in white pine areas on the Clearwater Timber Protective Association.

Heretofore chemical concentrations of .9# of sodium chlorate or 1.4# Atlacide per gallon of spray have been used. During the 1931 season .5# of sodium chlorate or 1# of Atlacide per gallon of spray was used up until August 15. It was noticed that a considerable amount of resprouting took place when these lesser concentrations of chemical were used, making it questionable as to whether a satisfactory kill will result.

Reeradication work consisted principally of respraying bushes of R. petiolare which were not killed by the chemical applied in 1929. No attempt was made to recheck all of the stream type for other Ribes species which may have been missed when initial eradication work was done.

RECOMMENDATIONS

1. It would perhaps be advisable to use stronger chemical solutions than .5# of sodium chlorate or 1# of Atlacide per gallon of spray.

2. During the 1932 season data regarding Ribes on the slopes of various drainages should be taken so that a complete control program can be made for the Clearwater Timber Protective Association. Part of this information is now available in reconnaissance data but supplementary work needs to be done in several townships.

3. It is recommended that a more mature type of labor be used on Ribes eradication projects than has been used heretofore.

4. It would aid materially in increasing the efficiency of the work done by each Ribes eradication unit if a checker were assigned to check the eradication work done by each camp within a week or two after the work had been completed. The work of such a man would tend to standardize the quality of eradication work done by all camps.

COOPERATIVE LOCAL CONTROL
POTLATCH TIMBER PROTECTIVE ASSOCIATION

By
W. G. Guernsey
Junior Forester

INTRODUCTION

The local control program of eradicating Ribes from the stream type of the Potlatch Timber Protective Association was continued during the 1931 season. In addition several upland areas were completely worked. Due to the concentration of the blister rust on white pine in two areas, it was necessary to pull all Ribes on these two upland infection centers. The first area is located at the junction of Three Bear and Long Meadow creeks and the second area is situated at the junction of Deep and Elk creeks. This marks the first departure from stream type eradication on the Association.

Blister rust has been found on white pine on practically all streams and areas west of Elk Creek. This fact will be of importance in the future plans for work on lands of the Association.

PURPOSE

The main purpose of local control is to prevent white pine being infected by blister rust. This is to be brought about by the eradication of all wild Ribes, which serve as a host for blister rust, from the stream type and upland areas.

LOCATION AND DESCRIPTION OF AREA

The eradication of Ribes in stream type was carried on and completed the work in working units 12, 13, 17, 18, 19. Also a portion of working units 22 and 23 was finished.

A part of the upland in working unit 4 was covered. This area is located at the junction of Three Bear and Long Meadow creeks. A second upland area covered is located at the junction of Deep and Elk creeks in working unit 7.

Practically all areas worked east of R. 2 E., Boise Meridian, are well covered with a mature stand of white pine, white fir, cedar, and larch. Ribes grow in abundance along the streams and ridge tops in this general area, these species being Ribes lacustre and R. viscosissimum.

The region west of Range 2 East, Boise Meridian, has a forest cover mainly of younger age classes made up of white pine, white fir and cedar. The older age classes are found in the southern and eastern parts of this region. The Ribes species consist of R. lacustre, R. petiolare, R. inerme and R. viscosissimum.

METHODS, EQUIPMENT AND MATERIALS

Four twenty-man camps under the supervision of a project supervisor were employed on the Potlatch Timber Protective Association during the past season. Ribes hand-pulling crews consisted of three men each. The spray crews were made up of one foreman and four crewmen. The methods employed by both crews are explained in detail in the 1929 annual report.

Standardized camp equipment, a Chevrolet truck and other general equipment were used as in previous years.

The chemical materials consisted of several mixtures. Sodium chlorate .5 pounds per gallon of water was used by spray crews until July 15. From July 15 to August 15 Atlacide was furnished in the proportion of one pound per gallon of water. After August 15 1.4 pounds of sodium chlorate was used. If it was necessary to use Atlacide after August 15, 1.4 pounds per gallon of water were used.

Elk River, Idaho, served as a center for food, chemical and equipment to be distributed to the various camps by truck and a ten-mule pack string.

WORK PERFORMED AND RESULTS

The following table shows the results of work performed:

TABLE NO. 1

SUMMARY BY BLOCKS OF RIBES ERADICATION BY HAND PULLING METHODS

Working Unit No.	Type	Acres	Man Days	Number of Ribes Pulled						Total Cost	Per Acre Basis		
				R. lac.	R. pet.	R. iner.	R. vis.	R. irr.	Total Ribes		Man Days	Ribes	Cost
4	Open Mature	199.0	103.5	11,935			3,039		14,974	$ 715.18	.52	75.2	$3.59
	Dense Repro.	480.0	239.5	27,299			7,765		35,064	1,654.94	.49	73.0	3.44
	Open Repro.	80.5	37.0	3,010			1,900		4,910	255.67	.45	60.9	3.17
	Dense Pole	76.5	39.0	2,589			747		3,336	269.49	.50	43.6	3.52
7	Stream	49.9	50.8	2,411	1,016		838	1,126	5,391	351.02	1.01	108.0	7.03
	Open Repro.	756.0	468.4	19,569	8,470		23,585	20,572	72,196	3,236.74	.61	95.4	4.28
12	Open Mature	7.5	7.0	200	10		175	110	495	48.37	.93	66.0	6.44
17	Stream	824.7	443.5	112,732	1,909		442		115,083	3,064.58	.53	139.5	3.71
18	Stream	833.5	583.5	238,357	237		3		238,597	4,031.98	.70	286.2	4.83
19	Stream	103.3	141.0	27,250	38,830				66,080	974.31	1.36	639.6	9.43
22	Stream	574.0	783.0	230,670	73,471				304,141	5,410.53	1.36	529.8	9.42
23	Stream	375.8	291.5	23,449		29,356	894		53,699	2,014.26	.77	142.8	5.35
	Open Repro.	567.2	200.9	73,294	543		16,835	1,884	92,556	1,388.21	.35	163.1	2.44
		8.0	1.5	257			108	2	367	10.36	.18	45.8	1.29
Totals or Averages		4,935.9	3,390.1	773,022	124,486	29,356	56,331	23,694	1,006,889	$23,425.64	.68	203.9	$4.74

TABLE NO. 2

SUMMARY BY BLOCKS OF RIBES ERADICATION BY SPRAYING METHODS IN STREAM TYPE

Working Unit No.	Method	Acres	Man Days	Gallons Spray	Total Cost	Per Acre Basis		
						Man Days	Gallons Spray	Cost
18	Hand	13.0	19.0	461	$ 201.43	1.4	35.4	$15.49
22	"	137.5	189.0	3,145	1,830.81	1.3	22.8	13.31
23	"	8.0	22.5	700	257.02	2.8	87.5	32.12
Totals or Ave.	"	158.5	230.5	4,306	$2,289.26	1.4	27.1	$14.44

TABLE NO. 3

RIBES

REERADICATION BY HAND PULLING METHODS

Working Unit No.	Type	Acres	Man Days	Number Ribes Pulled				Total Cost	Per Acre Basis		
				R. lac.	R. vis.	R. iner.	Total Ribes		Man Days	Ribes	Cost
10	Stream	189.5	113	9,924	602	21,063	31,589	$780.83	.59	166	$4.12

TABLE NO. 4

RIBES REERADICATION BY SPRAYING METHODS IN STREAM TYPE

Working Unit No.	Method	Acres	Man Days	Gallons Spray	Total Cost	Per Acre Basis		
						Man Days	Gallons Spray	Cost
10	Hand	246	128.5	2,674	$887.93	.52	10.8	$3.60

TABLE NO. 5

ANALYSIS OF RIBES ERADICATION BY HAND PULLING METHODS

Type	Acres Worked	Man Days Per Acre	Ribes Pulled Per Acre					
			R. lac.	R. vis.	R. pet.	R. iner.	R. irr.	Ribes Totals
Stream	3,271.6	.77	220.5	5.70	36.2	14.6	.20	277.40
Open Mature	214.0	.55	56.7	13.03		3.7	.09	73.58
Open Reproduction	767.0	1.27	25.5	30.08	1.1		26.90	84.30
Dense Reproduction	476.0	.50	57.3	16.20				73.60
Open Pole	12.0	.54	26.3	5.30				31.60
Dense Pole	54.5	.49	36.8	11.50				48.30
Stream*	189.5	.60	52.3	9.30		104.8		166.40

*Reeradication of Ribes carried on in the stream type of this area.

TABLE NO. 6

RIBES ERADICATION DATA BY WORKING UNITS

Working Unit	Acreage				Man Days	Number Ribes Pulled	Gals. Spray Used	Cost	
	Stream Type Worked	Upland Worked	Partially Protected	Completely Worked				Total	Per Acre
4	*	836.0		836.0	419.0	58,284		$ 2,895.29	$3.46
7	49.9	763.5		813.4	526.2	70,450		3,636.04	4.47
12	824.7		9,070.0		443.5	115,083		3,064.58	.33
17	833.5		4,850.0		583.5	238,597		4,031.98	.56
18	116.3		4,000.0		160.0	66,080	461	1,175.74	.29
19	574.0		12,080.0		783.0	304,141		5,419.53	.44
22	375.8		1,475.0		480.5	84,324	3,145	3,845.07	2.67
23	575.2		2,485.0		224.9	92,923	700	1,656.77	.66
Total or Ave.	3,349.4	1,599.0	33,960.0	1,649.4	3,620.6	1,029,882	4,306	$25,725.00	$ .71

Note: Unit 10 - Reeradication, 113 man days spent on 189.5 acres pulling 31,589 Ribes. 2,674 gallons spray used on 246 acres during 128.5 man days.

*Stream type worked in 1929.

STATEMENT AND ANALYSIS OF COSTS

Statement of Meal Costs:

Total cost of subsistence	$6,650.37
Number of meals served	19,571
Average cost per meal served	$.33

Statement of the composite cost per effective man day:

Total cost of operation		$27,660.11
Minus cost chemical equipment and repairs	$282.57	
Minus cost chemical	854.97	1,137.54
		$26,522.57

Divided by 3,862.1 man days actually hand pulling or spraying Ribes - cost of	$6.91 per day
Cost per man day on spraying including repairs and chemical equipment - $6.91 plus $.78	$7.69 per day
Cost per gallon of spray equals $\frac{\$854.97}{6,980}$ =	$.12 per gallon*

*The excess cost was due to practically all Atlacide being used in the chemical spray. Atlacide costs more per unit than sodium chlorate.

TABLE NO. 7

STATEMENT OF COST OF OPERATION

Item of Expenditure		Cost	
		Per Item	Total
Salaries and Wages	Supervisors	$ 3,760.00	
	Temporary field men	14,454.71	$18,214.71
Subsistence	Wages, cooks and flunkies	1,331.68	
	Cost of food	3,824.01	
	Transportation of food	1,156.15	
	Annual rental on subsistence equipment	233.00	
	Transportation of subsistence equipment	105.53	6,650.37
General Equipment	Annual rental	800.00	
	Transportation	316.61	
	Repairs	133.07	1,249.68
Chemical Equipment	Annual rental	191.72	
	Transportation	35.00	
	Repairs	55.85	282.57
Miscellaneous	Supplies	77.68	
	Expenses	173.16	
	Twine	95.00	
	Operation of cars by supervisors	61.97	407.81
Chemical Charge	Cost	639.00	
	Transportation	175.20	854.97
Grand Total			$27,660.11

TABLE NO. 8

CHRONOLOGICAL RECORD OF RIBES ERADICATION

Year	Expenditures	Acreage			Effective Man Days	Number Ribes Pulled	Gallons Spray Applied	Percentage of Association Lands to be Protected	
		Actually Worked	Partially Protected	Totally Worked				Totally Worked	Partially Protected
1928	*$15,530.52	537.4	10,000		# 395.2	105,036	18,909		2
	** 2,921.83				220.0	93,918			
1929	30,000.00	3,099.4	57,010		2,614.0	781,384	9,859		13
1930	30,000.00	6,747.4	165,000		4,140.5	1,428,635	17,960		40
1931	30,000.00	4,948.4	33,960	1,699	3,862.1	1,038,478	6,980	.3	8
Total to date	$108,452.35	15,332.6	265,970	1,699	11,231.8	3,447,451	53,708	.3	63

* Eradication carried on by methods projects.

**Reeradication by methods project on areas worked in 1928.

Effective hand pulling man days.

DISCUSSION AND ANALYSIS

It is not feasible to eradicate R. inerme by spraying with sodium chlorate solutions. No satisfactory kill of R. inerme live stem has been obtained by this method. There are numerous areas of this species on the Association that have been carefully sprayed and bear out these statements.

The camp bosses carried on a Ribes check of all areas covered by eradication crews. They tabulated the information in a specially made checking book for camp bosses. Any worked area having numerous Ribes left was immediately reworked by eradication crews, or the camp boss. This system increased the efficiency of the work to a marked degree.

A portion of the stream type covered in 1930 was reworked this year. A surprising amount of R. petiolare was found growing in the water along Johnson and Cameron creeks where spray had been applied. On areas that were fairly dry and spray had been applied to the R. petiolare only, a good live stem kill was the result. This would point to the necessity of using a higher concentration of spray or some other method where a large portion of bushes are under water.

RECOMMENDATIONS

1. It is recommended that complete eradication of Ribes in the stream type and uplands be started this next field season. This proposed change from eradicating Ribes in stream type only is due to white pine being infected by blister rust over a large part of the Potlatch Association lands.

2. A definite Ribes eradication working plan is necessary in order to properly protect white pine from blister rust. It is proposed to make such a plan for the Potlatch Timber Protective Association.

3. It is suggested that the methods project under the supervision of one man carry on a more intensive study of eradication methods. There are numerous obstacles to our field work in stream type and uplands on this association that require more intensive thought. Among these are: (1) The necessity of eradicating Ribes in a certain area leaving only a limited amount of live stem per acre for one eradication. These limits in Ribes live stem left per acre should be outlined for the first, second or third operation and year to carry on work according to a plan for control. (2) Our inability to properly eradicate Ribes inerme.



W. 959. An ideal situation for the development of blister rust. Forty to sixty year old white pine on the slopes. Very heavy R. petiolare and some R. inerme in wide stream type. Ribes sprayed in 1931; located on the upper St. Maries River four miles east of Clarkia, Idaho.



W. 960. Typical brushy stream bottom where Ribes are abundant, junction of French Creek and Orogrande Creek. Excellent 60-80 year old white pine on the slopes.

COOPERATIVE LOCAL CONTROL ON THE UPPER ST. MARIES RIVER DRAINAGE

By
W. G. Guernsey
Junior Forester

INTRODUCTION

The eradication of wild Ribes was carried on in a portion of the St. Maries River drainage during the past year. This was the first year practical control measures have been undertaken in that general area, the previous work consisting solely of experimental plots.

The Milwaukee Land Company, Rutledge Timber Company, and the State of Idaho cooperated with the Division of Blister-Rust Control in the Ribes eradication work. These agencies furnished financial assistance on the same basis that cooperative work has been carried on in the past. This marks the first year that the Milwaukee Land Company has cooperated in the eradication of Ribes and is a tribute to the policy of this Division.

PURPOSE

The main purpose of local control is to prevent white pine from being infected by blister rust. This is to be brought about by the eradication of all Ribes which serve as a host for blister rust, from the stream type and upland areas.

LOCATION AND DESCRIPTION OF AREA

The eradication of Ribes was carried on in the upper St. Maries River drainage in sections 8, 9, 10, 11, 14, 15, 16, 17, 23, 24, 26 and 27, township 42 north, range 2 east, Boise Meridian. Also, protection work was performed in township 42 north, range 3 east, Boise Meridian, in sections 12, 13, 24 and 25.

These areas have an excellent stand of white pine and white fir well distributed in the drainage protected. The timber age class averages well under 80 years of age. Topography, soil conditions, accessibility, and moisture are excellent for the growing of white pine as a timber crop.

METHODS, EQUIPMENT, AND MATERIALS

A supervisor, two camp bosses and two 23-man camps were employed on the St. Maries River drainage. The personnel of each camp was split up

into 3-man Ribes pulling crews and 5-man spraying crews. The method of application by type of crew is explained in detail in the 1929 annual report.

Atlacide and sodium chlorate were used in the same concentration of spraying solution as explained in the report on the Potlatch Ribes eradication unit.

One 7-mule pack string was used to move camp equipment and chemical the last part of the season. Pack strings and trucks were used jointly by the St. Maries River drainage and Potlatch Timber Protective Association jobs, and the coordination of transportation resulted in a very low cost to each.

WORK PERFORMED AND RESULTS

The following table shows the results of work performed:

TABLE NO. 1

SUMMARY OF RIBES ERADICATION BY HAND PULLING METHODS

Working Unit Number	Type	Acres	Man Days	Number Ribes Pulled					Total Cost	Per Acre Basis		
				R. lacustre	R. petiolare	R. inerme	R. visco.	Total		Man Days	Ribes	Cost
1	Stream	1,215.8	1,003.9	252,205	37,978	14,562	16,861	321,606	$5,943.19	.82	488.1	$4.88
	Dense Reproduction	326.2	125.0	9,551	9	305	13,202	23,067	740.00	.38	70.7	2.26
	Open Pole	190.0	120.0	3,434	294	-	26,951	30,679	710.40	.63	161.4	3.73
	Dense Pole	227.7	108.2	15,459	840	2,070	12,084	30,453	640.54	.47	133.7	2.81
	Dense Mature	11.5	3.5	383	3	-	269	655	20.72	.30	56.9	1.80
	Open Reproduction	33.5	37.0	2,033	-	99	7,536	9,668	219.04	1.10	288.5	6.53
Totals or Averages		2,004.7	1,397.6	283,065	39,124	17,036	76,903	416,128	$8,273.89	.69	280.8	$4.12

TABLE NO. 2

SUMMARY OF RIBES ERADICATION BY SPRAYING METHODS IN STREAM TYPE

Working Unit No.	Method	Acres	Man Days	Gallons Spray	Total Cost	Per Acre Basis		
						Man Days	Gallons Spray	Cost
1	Hand	480.20	1,107.1	20,647	$8,845.73	2.3	42.9	$18.42

TABLE NO. 3

ANALYSIS OF RIBES ERADICATION BY HAND PULLING METHODS

Type	Acres Worked	Man Days Per Acre	Ribes Pulled Per Acre				
			R. lacustre	R. visco.	R. petiolare	R. inerme	Totals
Stream	1,215.8	.83	207.4	13.8	31.20	11.9	264.5
Open Reproduction	33.5	1.13	60.6	224.0	-	2.9	288.6
Dense Reproduction	326.2	.37	29.2	40.4	.02	.9	70.6
Open Pole	190.0	.63	18.0	141.8	1.50	-	161.4
Dense Pole	227.7	.46	67.2	50.9	3.60	9.0	130.9
Dense Mature	11.5	.30	33.3	23.3	.20	-	56.9

TABLE NO. 4

ANALYSIS OF RIBES ERADICATION BY CHEMICAL SPRAYING METHODS

Eradication Class Gals.Per Acre	Acres Worked	Man Days Per Acre	Gals.Spray Per Acre
21-40	76.7	1.25	31.2
41-80	190.9	1.93	57.4
81-160	178.6	3.14	97.9
161-320	7.8	5.76	193.3
Totals or Averages	454.0	2.36	71.3

TABLE NO. 5

RIBES ERADICATION DATA BY WORKING UNITS

Working Unit	Acreage					Number Ribes Pulled	Gals. Spray Used	Cost	
	Stream Type	Upland	Partially Protected	Completely Worked	Man Days			Total	Per Acre
1	1,204.6	5,225.4	-	6,430	2,584.7	409,873	20,647	$17,722.48	$2.75

STATEMENT AND ANALYSIS OF COSTS

TABLE NO. 6

STATEMENT OF COST OF OPERATION

Item of Expenditure		Cost	
		Per Item	Total
Salaries and Wages	Supervisors	$2,520.00	
	Temporary field men	8,548.53	$11,068.53
Subsistence	Wages Cooks and flunkies	705.35	
	Cost of food	1,911.49	
	Transportation of food	535.62	
	Annual rental on subsistence equipment	126.70	
	Transportation on subsistence equipment	37.30	3,316.46
General Equipment	Annual rental	465.08	
	Transportation	149.24	
	Repairs	122.61	736.93
Chemical Equipment	Annual rental	191.72	
	Transportation	31.90	
	Repairs	80.29	303.91
Miscellaneous	Supplies	53.39	
	Expenses	3.57	
	Twine	105.34	
	Operation of cars by supervisors	30.88	193.18
Chemical Charge	Cost	1,516.78	
	Transportation	586.69	2,103.47
Grand Total			$17,722.48

Statement of meal costs:

Total cost of subsistence.....$3,316.46
Number meals served.....10,633
Average cost per meal served...$.31

Statement of the composite cost per effective man day:

Total cost of operation		$17,722.48
Minus cost chemical equipment and repairs	$303.91	
Minus cost chemical and transportation	2,103.47	2,407.38
		$15,315.10

Divided by 2584.7 man days actually hand pulling or spraying Ribes = $5.92 cost per man day.
Cost per man day on spraying, including repairs and chemical equipment $5.92 plus .27=$6.19
Cost per gallon spray equal $2,103.47 / Gallons spray 20,647 = 10¢ per gallon.

DISCUSSION AND ANALYSIS

The larger part of the time was expended in working the stream type along the upper St. Maries River drainage. There exists a rank growth of brush, Ribes and smaller vegetative growth in this type. This retarded the speed of the working to some extent and also increased the difficulty of properly spraying R. petiolare and R. inerme. There is no doubt that more work will be necessary on the eradication of Ribes to completely protect the area covered this past year. This is due to our inability to effectively kill R. inerme by hand pulling or spraying methods during the past year.

The uplands are well covered with a young stand of white pine. The Ribes were concentrated in the openings of reproduction and scattered along the ridges, which, by centralizing the work of the crew, facilitated eradication.

Any areas not covered by intensive crew work were stripped by the camp boss or supervisor. This method of running strips at ten-chain intervals in heavy reproduction to check for Ribes areas not covered by crews, proved very satisfactory. The camp boss and project supervisor also spent considerable time examining openings in the stands for Ribes concentrations, and pulling the Ribes if they were too few for crew work. If numerous Ribes were located, crews were sent to pull them. This insured proper protection and was a sure method of locating and examining an area for Ribes.

RECOMMENDATIONS

A definite Ribes eradication working plan for a region is necessary in order to properly protect white pine from damage by blister rust. It is

proposed to make such a plan for all areas in the upper St. Maries River drainage.

PRELIMINARY RIBES ERADICATION SURVEY

It is necessary to obtain general information on Ribes species, their concentration and location before any feasible Ribes eradication program can be planned. This information was obtained on the upper St. Maries River drainage areas surrounding the eradication work of 1931.

A careful survey was made of 70 sections located in townships 42 and 43 north, ranges 1 and 2 east, Boise Meridian. This area will provide four 20-man eradication camps a full season's work. The detailed information acquired was placed on a map and will be kept in the map files for reference.

COOPERATIVE LOCAL CONTROL, PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION

By
Homer J. Hartman
Junior Forester

INTRODUCTION

Intensive scouting during the summers of 1929 and 1930 failed to reveal the presence of white pine blister rust within the Priest Lake Timber Protective Association. However, extensive scouting on the Kaniksu National Forest in the same vicinity revealed, as early as 1928, several Ribes infection centers. The scarcity of white pine blister rust in the Priest Lake region is due primarily to the nearly complete absence of Ribes petiolare throughout the area. However, R. inerme, R. lacustre, and R. viscosissimum occur in such concentrations over large areas that once white pine blister rust becomes established it will very rapidly play havoc with the present valuable white pine stands.

The first step toward local control on the Priest Lake Timber Protective Association was made in 1928 by the association in cooperation with the Division of Blister Rust Control. At that time the Ribes eradication organization consisted of one twenty-five man unit which concentrated its efforts on the Big Creek working unit. There were 8,457 acres of stream and upland type completely worked at a cost of $1.08 per acre, or a total cost of $9,108.04. This work involved the removal of 577,945 Ribes bushes.

The control program was resumed in 1931. The work was performed under the supervision of the Division of Blister Rust Control and in cooperation with the State of Idaho. The North Fork of East River working unit was selected by the Idaho State Forester in accordance with recommendations of the Division of Blister Rust Control as the most advantageous area for establishing the new local control program.

PURPOSE OF WORK

The purpose of the work was the local control of white pine blister rust by hand eradication of Ribes from the area selected.

LOCATION AND DESCRIPTION OF AREA

The North Fork of East River working unit includes all of the North Fork of East River and Waters Creek drainages west to the east side Priest River-Coolin road and lies within townships 58 and 59 north and ranges 3 and 4 west, Boise meridian. The topography is generally rough with elevations ranging from 2,600 to 6,700 feet.

The area is an excellent white pine site no part of which has been logged. The upper portion of the west side of the North Fork drainage has been heavily burned leaving a part of the area in brush lands. However, the major part of the working unit is mature white pine type while the lower portion is heavily covered by immature white pine.

R. lacustre and R. viscosissimum are generally distributed over the area, R. inerme is found in dense concentrations in the stream type along the lower part of the main North Fork of East River. R. petiolare does not occur in sufficient quantity to be of any importance.

METHODS AND EQUIPMENT

The personnel consisted of two twenty-man units including cooks and part time flunkies. Due to the small quantity of R. petiolare and the limited amount of R. inerme on the area the work was done entirely by hand pulling methods. The men were divided into the standard 3-man crews, and the individual crews conducted their work in the usual manner.

Both stream and upland types were worked. Areas free of Ribes and those having less than fifty feet of live stem per acre were scouted out by the camp boss and were blocked out from the area to be covered by the crews.

A pack string, which was rented on part time basis from the Forest Service, was used for transporting supplies to the upper camp. Charges for the use of this stock, which amounted to about one day and a half a week, were made against the project only for the time the pack string was actually being used. A telephone was installed at the lower camp by the Forest Service for emergency fire use. Each camp was equipped with two standard smokechaser fire suppression packs. During the field season approximately 305 man days were spent fighting forest fires.

WORK PERFORMED AND RESULTS

The following tables show a summary of the work accomplished on the Priest Lake Timber Protective Association in 1931:

TABLE NO. 1

ANALYSIS OF RIBES ERADICATION BY HAND PULLING METHODS ON PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION

Ribes Class	Acres Worked	Ribes Pulled Per Acre					Man Days Per Acre
		R. lac.	R. pet.	R. iner.	R. visco.	Total	
Stream Type							
0-25*	143.0	12.84	-	-	-	12.84	.07
26-50	64.0	37.48	-	2.18	2.59	42.26	.31
51-100	295.9	81.20	.03	1.56	1.59	84.39	.28
101-200	286.9	133.88	-	8.36	.95	143.20	.40
201-400	178.5	224.10	-	37.13	.58	261.82	.64
401-800	95.5	414.77	-	176.04	5.41	596.23	1.26
801-1600	49.3	588.53	-	529.18	9.02	1,126.75	2.02
1601-3200	47.7	723.54	3.81	946.43	.69	1,674.48	2.40
3201 & Over	6.3	757.46	-	3,774.10	-	4,531.58	6.12
Totals or Averages	1,045.6	205.20	.18	116.10	1.92	323.30	.69
Open Mature							
0-25	2,598.0	6.03	-	-	.43	6.46	.03
26-50	581.0	36.75	-	-	1.33	38.09	.09
51-100	957.0	67.51	-	-	3.84	71.36	.12
101-200	1,195.5	135.28	-	-	5.99	141.27	.18
201-400	680.5	249.11	-	-	25.66	274.78	.38
401-800	187.0	516.87	-	-	14.23	531.10	.61
801-1600	38.0	927.21	-	-	44.92	972.13	1.10
1601-3200	3.5	1,782.20	-	-	-	1,782.80	1.71
Totals or Averages	6,240.5	91.51	-	-	5.54	97.05	.14
Dense Mature							
0-25	1,098.0	5.65	-	-	.57	6.22	.03
26-50	51.5	33.35	-	-	1.37	34.73	.14
51-100	80.5	67.24	-	-	4.55	71.80	.13
101-200	126.0	150.20	-	-	4.85	155.07	.23
201-400	62.0	242.20	-	-	.38	242.62	.34
Totals or Averages	1,418.0	33.30	-	-	1.20	34.50	.08

*Ribes bushes per acre.

TABLE NO. 1 (Cont'd)

ANALYSIS OF RIBES ERADICATION BY HAND PULLING METHODS ON PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION

Ribes Class	Acres Worked	Ribes Pulled Per Acre					Man Days Per Acre
		R. lac.	R. pet.	R. iner.	R. vis.	Total	
Open Pole							
0-25	146.3	10.62	-	-	.64	11.27	.13
26-50	28.0	26.21	-	-	1.50	27.71	.10
51-100	50.0	61.14	-	-	6.10	67.24	.22
Totals or Averages	224.3	23.86	-	-	1.97	25.83	.15
Open Reproduction							
0-25	699.0	3.76	-	-	1.45	5.21	.04
26-50	28.0	5.39	-	-	34.82	40.21	.12
51-100	6.0	.16	-	-	86.50	86.66	.31
101-200	7.0	30.30	-	-	116.50	146.85	.44
Totals or Averages	740.0	4.04	-	-	4.49	8.53	.05
Dense Reproduction							
0-25	1,260.2	2.78	-	-	1.61	4.40	.05
26-50	88.5	8.79	-	-	23.70	32.53	.13
51-100	45.0	35.70	-	-	30.20	66.00	.27
101-200	4.0	90.50	-	-	38.50	129.00	.37
201-400	2.0	176.50	-	-	117.50	294.00	.55
Totals or Averages	1,399.7	4.72	-	-	4.20	8.92	.06

TABLE NO. 2

SUMMARY BY TIMBER TYPES OF RIBES ERADICATION, PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION

Working Unit No.	Type	Acres	Man Days	Number Ribes Pulled					Total Cost	Per Acre Basis		
				R. lac.	R. pet.	R. inerme	R. vis.	Total		Man Days	Ribes	Cost
4	Stream	1,045.6	719.8	214,589	193	121,453	2,011	338,246	$ 4,968.51	.68	323.4	$4.75
	Open Mature	6,240.5	900.4	571,029	-	-	34,587	605,616	6,215.06	.14	97.0	1.00
	Dense Mature	1,418.0	108.9	47,289	-	-	1,702	48,991	751.68	.07	34.5	.53
	Open Reproduction	740.0	38.6	2,993	-	-	3,328	6,321	266.44	.05	8.5	.36
	Dense Reproduction	1,399.7	90.9	6,608	-	-	5,893	12,501	627.43	.06	8.9	.45
	Open Pole	224.3	33.5	5,345	-	-	442	5,787	231.24	.14	25.8	1.03
Tot. or Ave.		11,068.1	1,892.1	847,853	193	121,453	47,963	1,017,462	$13,060.36	.17	91.9	$1.18

TABLE NO. 3

RIBES ERADICATION DATA BY WORKING UNITS

Working Unit No.	Acreage				Total Man Days	Number Ribes Pulled	Cost	
	Stream Type	Upland	Partially Protected	Completely Worked			Total	Per Acre
4	1,045.6	10,022.5	-	11,068.1	1,892.1	1,017,462	$13,060.36	$1.18

STATEMENT AND ANALYSIS OF COSTS

TABLE NO. 4

STATEMENT OF COST OF OPERATION

Item of Expenditure		Cost	
		Per Item	Total
Salaries	Supervisors	$2,271.65	
	Temporary field men	6,876.09	$ 9,147.74
Subsistence	Wages, cooks and flunkies	745.84	
	Cost of food	2,146.56	
	Transportation of food	327.10	
	Annual Rental of subsistence equipment	194.04	
	Transportation of subsistence equip.	45.25	$ 3,458.79
General Equipment	Annual rental	502.00	
	Repairs	168.43	
	Transportation	80.22	$ 750.65
Miscellaneous	Supplies	47.25	
	Expenses	61.65	
	Twine	196.68	$ 305.58
Total			$13,662.76
Subsistence charge against Methods Employees - (502 man days @ $1.20).			-602.40
Grand Total			$13,060.36

STATEMENT OF MEAL COSTS

Total cost of subsistence.....$3,458.79
Number of meals served.....11,031
Average cost per meal served.....$.313

The subsistence charge against the methods employees was included in order to obtain the true meal cost.

STATEMENT OF THE COMPOSITE COST PER EFFECTIVE MAN DAY

Total cost of operation.....$13,060.36
Total number of foreman and crewman days.....1,892.1
Cost per effective man day.....$6.90

TABLE NO. 5

CHRONOLOGICAL RECORD OF RIBES ERADICATION,
PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION

Year	Expenditures	Acreage			Effective Man Days	Number Ribes Pulled	Per Cent Area to be Worked	
		Actually Worked	Partially Worked	Totally Protected			Totally Worked	Partially Protected
1928	$10,000	8,457.2	-	8,457.2	1,574.0	577,945	6.6	-
1931	15,000	11,068.1	-	11,068.1	1,892.1	1,017,462	8.7	-
Tot.	$25,000	19,525.3	-	19,525.3	3,466.1	1,595,407	15.3	-

DISCUSSION AND ANALYSIS

Stream type represented 9 per cent of the total acreage worked, required 38 per cent of the total man days and contained 33 per cent of the total number of Ribes removed. In making estimates for future Ribes eradication on the Priest Lake Timber Protective Association it is safe to assume that two-thirds of the work occurs in the upland type.

RECOMMENDATIONS FOR FUTURE WORK

Every possible effort should be made to increase the the operations so as to complete the initial Ribes eradication over the area at the earliest date possible.

Where both stream and upland types are being worked on areas heavily populated with Ribes it is suggested that twenty-five to thirty man units be used. The mobility of camp equipment is of little consequence, as camps engaged in such work seldom move even once during the season. By establishing such units the comparative cost of overhead would be reduced. More concentrated and efficient supervision could be given by the project leader, or supervisor.

The field personnel of the Division of Blister Rust Control forms an important first and second-line emergency defense in forest fire suppression, and even a small part in fire detection. Camps are often located in very inaccessible areas of high fire hazard. It is suggested that the Division of Blister Rust Control work out, with its cooperators, a complete preparedness plan for fire suppression. Not less than an eight-man fire fighting outfit should be made available to each camp. Telephones should be installed whenever possible.

PREERADICATION SURVEY ON PRIEST LAKE TIMBER PROTECTIVE ASSOCIATION

Following the close of the 1931 Ribes eradication field season a preeradication survey was made on Soldier, Cougar, Hunt, Indian, Bear and Two Mouth drainages of the Priest Lake Timber Protective Association in order to obtain the necessary information for planning the field organization and estimating the cost of conducting Ribes eradication on any or all of these drainages. These drainages lie within townships 60, 61 and 62 north and ranges 3 and 4 west, Boise principal meridian.

Of the 73,740 acres examined approximately 24,880 acres supported nearly pure stands of mature white pine occurring in large centralized blocks with definite type lines. A large percentage of the white pine stands were so dense that the Ribes had been shaded out, leaving a Ribes-free condition requiring little or no work. Immature western white pine covered 8,320 acres, most of this being found in the Soldier and Hunt Creek drainages. Stands of other species, recent burns, and barren lands found mostly in the heads of the drainages and along the ridge tops constituted 40,540 acres of the total area covered. Scattered stands of white bark pine are found on the higher elevations.

R. lacustre is the dominate species found on the area, and it occurs only in medium to light concentrations in stream and upland types. R. viscosissimum is found in light concentrations in upland timber types and in medium concentrations in burns. R. inerme exists in dense masses in the lower two miles of stream type on Soldier Creek and in medium concentration in the lower miles of stream type on Bear Creek, making a total of forty-two acres. R. triste is found in medium concentrations of small extent in the alpine type in the heads of drainages. R. petiolare does not exist on the area surveyed.

The drainages covered in the preeradication survey form one of the best blister rust control areas in the Inland Empire, from the standpoint of cost of protection and Ribes species present. There is an abundance of well centralized, easily accessible white pine on the area, while the Ribes population is extremely low. Due to existing Ribes conditions the entire area should be worked by hand pulling methods.

SCOUTING FOR BLISTER RUST IN THE INLAND EMPIRE
1931

by
E. L. Joy
Junior Forester

INTRODUCTION

In 1929 scouting in the Inland Empire revealed the fact that blister rust on Ribes or on pines was scattered over practically the entire white pine region. The disease was found to occur in greatest abundance in the southern part of this region coincidental with the occurrence of large quantities of Ribes petiolare. Scouting done in 1930 and 1931 has shown that the disease is still more prevalent within this area than in the northern part of the white pine region.

PURPOSE

The purpose of scouting is to determine the extent and intensity of the disease. In conjunction with scouting, data are taken from which a stream type Ribes distribution map will be made.

NORTHERN IDAHO

A. Location of Work

During 1931 scouting was performed on the Selway, Clearwater, St. Joe and Coeur d'Alene national forests, and on the Clearwater, Potlatch, Coeur d'Alene, and Priest Lake timber protective associations.

B. Organization

A two-man crew worked intensively that portion of the St. Joe National Forest north of the St. Joe River as far east as Bird Creek and south of the river in the vicinity of Avery; the southern portion of the Coeur d'Alene National Forest as far north as the North Fork of the Coeur d'Alene River; and the Coeur d'Alene Timber Protective Association area adjacent to the St. Joe River from St. Maries, Idaho, east to the St. Joe National Forest boundary. Scouting was performed on the Potlatch, Clearwater, and Priest Lake timber protective associations and the Clearwater and Selway national forests in conjunction with other disease study work and Ribes eradication.

C. Results

Previous to 1931 scouting had revealed a total of 15 pine infections in northern Idaho and one just across the state line at Newman Lake, Washington. The Newman Lake infection is included here because of its important relationship to the other known pine infections. Five of these centers are pobably of 1923 origin. The 1931 work increased the total number of known pine infections in this region to 61, 11 of which are probably of 1923 origin.

Following is Table No. 1 showing pertinent information about each of the 61 known infections, and Table No.2 showing the distribution of these centers classified according to the year of location and the probable year in which the center was started.

TABLE NO. 1

KNOWN PINE INFECTION CENTERS IN THE INLAND EMPIRE

St. Joe National Forest

County	Location	Township	Range	Section	Year Found	Extent of Area		Pine Data					Number Cankers	Probable Year Origin	Associated Ribes
						Length	Width	Age	Number Per Acre	Number Examined	Number Infected	Per Cent Infected			
Shoshone	Railroad Creek	47N	5E	28	1931	Spot		1-20	100	200	2	1.0	2	1927	R. petiolare R. viscosissimum R. lacustre
	Champion Creek	47N	5E	27	1931	Spot		1-20	50	200	3	1.5	5	1927	R. petiolare R. viscosissimum R. lacustre
	No Name Creek	47N	5E	34	1931	Spot		1-20	100	500	1	0.2	1	1928	R. petiolare R. viscosissimum R. lacustre
	Lucky Swede Creek	46N	6E	6	1931	Spot		1-20	200	150	2	1.3	2	1927	R. petiolare R. viscosissimum R. lacustre R. irriguum
	Little North Fork St. Joe River	46N	6E	6	1931	Spot		1-20	50	350	3	0.9	3	1927	R. petiolare R. lacustre R. viscosissimum R. irriguum
	Ward Creek	46N	7E	20	1931	Spot		1-20	10	100	1	1.0	1	1927	R. petiolare R. viscosissimum R. lacustre
	Kelley Creek	46N	7E	7	1931	Spot		1-20	10	150	1	0.7	1	1927	R. petiolare R. viscosissimum R. lacustre
	Turkey Creek	46N	7E	18	1931	Spot		1-20	10	100	1	1.0	1	1927	R. petiolare R. viscosissimum R. lacustre
	Cliff Creek	47N	6E	35	1931	Spot		1-20	10	300	6	2.0	9	1927	R. petiolare R. viscosissimum R. lacustre
	Loop Creek	46N	6E	4	1931	Spot		1-20	100	100	1	1.0	1	1927	R. petiolare R. inerme R. viscosissimum R. lacustre
	Loop Creek	46N	6E	12	1931	Spot		1-20	100	200	1	0.5	1	1927	R. petiolare R. inerme R. viscosissimum R. lacustre
	Loop Creek	46N	7E	18	1931	Spot		1-20	100	100	1	1.0	1	1927	R. petiolare R. inerme R. viscosissimum R. lacustre
	St. Joe River	45N	6E	22	1931	Spot		1-40	10	200	2	1.0	2	1927	R. irriguum R. viscosissimum R. lacustre
	St. Joe River	45N	6E	23	1931	Spot		1-40	10	100	1	1.0	4	1927	R. viscosissimum R. irriguum R. lacustre
	Bird Creek	45N	6E	13	1931	Spot		1-40	10	50	1	2.0	1	1927	R. petiolare R. viscosissimum R. irriguum R. lacustre
	Kyle Creek	46N	5E	13	1931	Spot		1-60	50	200	1	0.5	1	1927	R. petiolare R. viscosissimum R. lacustre
	Hammond Creek	46N	5E	25	1930 1931	Spot		1-40	500	300	2	0.7	2	1927	R. petiolare R. viscosissimum R. lacustre
	Fishhook Creek	45N	5E	17	1931	Spot		1-40	250	100	4	4.0	4	1927	R. viscosissimum R. lacustre
	Fishhook Creek	45N	5E	17	1931	Spot		1-40	250	100	2	2.0	2	1927	R. viscosissimum R. lacustre
	Fishhook Creek	45N	5E	20	1931	Spot		1-40	250	100	1	1.0	1	1927	R. viscosissimum R. lacustre
	Fishhook Creek	44N	5E	4,5 8,9	1931	100 Chain	2-10 Chain	1-40	250	3,000 (Estimated)	1,500 (Estimated)	50 (Estimated)	150,000 (Estimated)	1923	R. petiolare R. viscosissimum R. irriguum R. lacustre
	Slate Creek	47N	4E	36	1931	Spot		1-20	300	200	1	0.5	1	1927	R. petiolare R. inerme R. irriguum R. lacustre R. viscosissimum
	Slate Creek	46N	4E	14	1931	Spot		1-20	300	900	4	0.4	4	1927	R. petiolare R. irriguum R. inerme R. viscosissimum R. lacustre
	Slate Creek	46N	4E	27	1931	Spot		1-20	300	400	2	0.5	2	1927	R. petiolare R. inerme R. irriguum R. viscosissimum R. lacustre
	St. Joe River	45N	3E	6	1931	Spot		1-20	100	400	3	0.8	3	1927	R. viscosissimum R. lacustre
	Coeur d'Alene National Forest														
	South Fork Coeur d'Alene River	48N	6E	35	1931	Spot		1-40	100	600	1	0.2	1	1927	R. petiolare R. viscosissimum R. lacustre
	Brown Creek	50N	3E	14	1931	Spot		1-20	250	800	2	0.2	2	1926	R. viscosissimum R. lacustre

(Continued)

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TABLE NO. 1 (Continued)

KNOWN PINE INFECTION CENTERS IN THE INLAND EMPIRE

Coeur d'Alene Timber Protective Association

County	Location	Township	Range	Section	Year Found	Extent of Area		Pine Data					Number Cankers	Probable Year Origin	Associated Ribes
						Length	Width	Age	Number Per Acre	Number Examined	Number Infected	Per Cent Infected			
Shoshone	Pine Creek	47N	1E	13	1931	Spot		1-20	500	1,500	1	0.1	1	1927	R. irriguum R. viscosissimum R. lacustre
	Mica Creek	44N	2E	4,5 7,8 17	1931	240 Chain	2 Chain	1-20	500	800	50 (Estimated)	6.7	100 (Estimated)	1927	R. petiolare R. viscosissimum R. lacustre
	Marble Creek	44N	2E	34	1931	20 Chain	2 Chain	1-20	500	400	4	1.0	7	1926	R. petiolare R. viscosissimum R. lacustre
	Marble Creek	44N	2E	35	1931	20 Chain	2 Chain	1-20	500	400	4	1.0	4	1927	R. petiolare R. viscosissimum R. lacustre
	St. Maries River	42N	2E	5, 8-11	1929 1930	480 Chain	3-12 Chain	21-40	500	403	46	11.3	21,000 (Estimated)	1923	R. petiolare R. inerme R. viscosissimum R. lacustre
	Merry Creek	43N	2E	33	1930	10 Chain	2 Chain	21-40	500	1,000	100	10.0	700 (Estimated)	1927	R. petiolare R. triste R. inerme R. viscosissimum R. lacustre
Potlatch Timber Protective Association															
Clearwater	Elk Creek	40N	2E	14	1931	Spot		1-20	100	50	2	4.0	2	1927	R. petiolare R. inerme R. viscosissimum R. lacustre
	Bobs Creek	41N	1E	22	1931	Spot		1-20	10	20	1	5.0	1	1927	R. petiolare R. inerme R. viscosissimum R. lacustre
	East Fork Potlatch Creek	41N	1E	36	1931	Spot		21-40	100	300	3	1.0	3	1923	R. petiolare R. inerme R. viscosissimum R. lacustre
Latah	Ruby Creek	40N 40N	1E 1W	15-18 13	1931	480 Chain	5-30 Chain	21-40	400	827	454	54.9	8,457	1923	R. petiolare R. inerme R. viscosissimum R. lacustre
Clearwater	Bull Run Creek	39N	2E	10	1931	Spot		21-40	200	100	2	2.0	3	1927	R. petiolare R. viscosissimum R. lacustre
	Deep Creek	39N	3E	6	1931	20 Chain	10 Chain	1-20	300	7,129	556	7.8	989	1923	R. petiolare R. viscosissimum R. lacustre
	Cameron Creek	40N	2E	33	1931	5 Chain	1 Chain	21-40	25	25	20	80.0	250	1927	R. petiolare R. lacustre
	Cameron Creek	40N	2E	31	1930	Spot		1-40	300	75	5	6.7	5	1927	R. petiolare R. lacustre
	Cameron Creek	40N	1E	25	1930	Spot		21-40	200	20	4	20.0	8	1927	R. petiolare R. lacustre
	Johnson Creek	40N	2E	19	1930	Spot		1-20	100	250	9	3.6	16	1927	R. petiolare R. inerme R. viscosissimum R. lacustre
	Shattuck Creek	40N	2E	28	1930	Spot		1-20	100	200	1	0.5	1	1927	R. petiolare R. inerme R. viscosissimum R. lacustre
	Deep-Elk Creek	39N	2E	14	1929 1930	240 Chain	5-30 Chain	11-40	336	612	306 (Estimated)	50.0	1,251 (Estimated)	1923	R. petiolare R. irriguum R. viscosissimum R. lacustre
	Three Bear-Long Meadow Creek	39N	1E	14	1929 1930 1931	60 Chain	5-40 Chain	11-40	754	1,422	341	24.0	227,683 (Estimated)	1923	R. viscosissimum R. lacustre
Clearwater Timber Protective Association															
	Deer Creek	38N	5E	23 26	1931	60 Chain	2-5 Chain	21-40	500	1,000	166	16.6	310	1923	R. petiolare R. lacustre
	Rhodes Creek	37N	5E	36	1930 1931	10 Chain	5 Chain	21-40	700	1,000	105	10.5	328	1923	R. petiolare R. viscosissimum R. lacustre
	Parallel Creek	38N	5E	8	1931	Spot		21-40	100	100	4	4.0	11	1927	R. petiolare R. viscosissimum R. lacustre
	Casey Creek	38N	5E	5	1931	Spot		21-40	100	100	1	1.0	1	1927	R. petiolare R. viscosissimum R. lacustre
	South Fork Reed's Creek	38N	5E	22	1931	5 Chain	1 Chain	21-40	100	300	28	9.1	40	1927	R. petiolare R. lacustre
	South Fork Reed's Creek	38N	5E	26	1931	Spot		21-40	500	100	2	2.0	2	1927	R. petiolare R. lacustre
	Snake Creek	38N	4E	36	1931	20 Chain	1-2 Chain	21-40	1,000	300	76	25.3	141	1923	R. petiolare R. lacustre
	Quartz Creek	37N	5E	9	1930 1931	20 Chain	1-5 Chain	21-40	100	500	40	8.0	48	1927	R. petiolare R. lacustre
	Poorman Creek	37N	4E	13	1931	Spot		21-40	300	1,000	1	0.1	1	1927	R. petiolare R. lacustre
	North Fork Reed's Creek	38N	5E	15	1930	2 Chain	2 Chain	21-40	50	50	7	14.0	68	1927	R. petiolare R. lacustre
	North Fork Reed's Creek	38N	5E	16	1929 1930	2 Chain	1 Chain	21-40	50	50	6	12.0	64	1927	R. petiolare R. lacustre
	Orofino Creek	36N	5E	13	1930	4 Chain	1 Chain	1-20	250	300	13	4.3	36	1928	R. petiolare R. viscosissimum R. lacustre
Clearwater National Forest															
	Beaver Creek	40N	7E	7	1930	1 Chain	1 Chain	21-40	25	10	4	40.0	80	1927	R. petiolare R. lacustre
	Weitas Creek	37N	8E	10	1931	Incomplete		1-40	Incomplete	Incomplete	1	?	1	? 1927	R. petiolare R. viscosissimum R. lacustre
Northeastern Washington															
Spokane	Newman Lake, Washington	27N 26N	45E 45E	32,33 4-5	1929 1930 1931	30 Chain	1-20	1-40	250	1,225	122	10.0	1,821	1923	R. inerme R. lacustre

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TABLE NO. 2

DISTRIBUTION BY FOREST UNITS OF KNOWN PINE INFECTIONS ACCORDING TO YEAR OF LOCATION AND PROBABLE YEAR OF ORIGIN

Forest Unit	Pine Infections Located								
	Before 1931			1931			All Years		
	Origin 1923	Origin Since 1923	Total	Origin 1923	Origin Since 1923	Total	Origin 1923	Origin Since 1923	Total
St. Joe N. F.	0	1	1	1	23	24	1	24	25
Coeur d'Alene N. F.	0	0	0	0	2	2	0	2	2
Clearwater N. F.	0	1	1	0	1	1	0	2	2
Coeur d'Alene T. P. A.	1	1	2	0	4	4	1	5	6
Potlatch T.P.A.	2	4	6	3	4	7	5	8	13
Clearwater T.P.A.	1	4	5	2	5	7	3	9	12
Newman Lake, Wn. Mt.Spokane Area	1	0	1	0	0	0	1	0	1
Totals	5	11	16	6	39	45	11	50	61

D. Discussion

Thirty-one per cent of the 16 pine infection centers found previous to 1931 originated about 1923 and the remaining 69 per cent in the years 1926, 1927, and 1928. Of the 45 centers found in 1931, which constitute 74 per cent of the total known infections, only 6 or 13 per cent were of 1923 origin, the remaining 39 or 87 per cent having originated in the later years. It is apparent, therefore, that although we will continue to find a few pine infections dating back to 1923, which we consider as the year the disease entered the Inland Empire, the greatest number of infections found each year will be of later origin. It is also evident that with equal amounts of scouting the total number of infections located each successive year will increase.

It is significant that, with the exception of the center at Newman Lake, Washington, the pine infections located thus far are confined to the area extending from the Clearwater National Forest north to the Coeur d'Alene National Forest, the portion of the white pine belt in which R. petiolare occurs in abundance. Table No. 2 shows that: (1) the largest number of infection centers on any one forest unit has been located on the St. Joe National Forest where R. petiolare is abundant; (2) the smallest number of infections has been found on the Clearwater and Coeur d'Alene forests, which units mark the southern and northern limits of the R. petiolare belt; and (3) 10 of the 11 oldest (1923) centers were located within the interior portion of this belt where R. petiolare is usually found in dense masses and where the optimum conditions for white pine growth occur.

Based on studies conducted at each center located, the 60 known pine infections within the R. petiolare belt have been classified according to the Ribes species probably responsible for introducing the disease at each point and the probable year each center was started. This classification is shown in Table No. 3.

TABLE NO. 3

THE 60 KNOWN PINE INFECTION CENTERS WITHIN THE R. PETIOLARE BELT CLASSIFIED BY RIBES SPECIES PROBABLY INTRODUCING THE DISEASE AND PROBABLE YEAR ORIGIN

Ribes Species	Ribes petiolare			Ribes viscosissimum			Ribes irriguum		
Probable Year of Origin	1923	Since 1923	Total	1923	Since 1923	Total	1923	Since 1923	Total
Number of Infections	9	42	51	1	6	7	0	2	2
Per Cent of Infections	90	84	85	10	12	12	0	4	3

From this table it appears that to date R. petiolare has been the major species responsible for both the introduction of the disease and its spread in the Inland Empire white pine belt. However, we must take cognizance of the fact that 10 per cent of the old centers and 15 per cent of the total centers found within this belt have been started by Ribes species other than R. petiolare. This fact indicates that although R. petiolare has been the host responsible for the occurrence of most of the known infection centers, the presence of other Ribes species in stands of white pine will eventually cause considerable pine infection where the disease is already established in the vicinity.

Scouting in northern Idaho outside the R. petiolare belt did not result in the location of infection in 1931. The areas scouted were along the Selway and Lochsa rivers of the Selway National Forest and along the east side of Priest Lake on the Priest Lake Timber Protective Association.

On the Selway, which is south of the Clearwater Forest, several small areas of thrifty young pine were found along tributaries on the north side of the Lochsa River. In general the area scouted bears a stand of Douglas fir and yellow pine or is severely burned over. The Ribes species found in the order of their abundance, are R. viscosissimum, R. lacustre, R. inerme and R. petiolare. R. petiolare was found in small scattered clumps along only one stream.

Scouting on the Priest Lake Timber Protective Association along the east side of Priest Lake was performed by members of the Ribes eradication forces. The Ribes species found, in the order of their abundance, are R. lacustre, R. inerme, R. viscosissimum and R. triste,

E. Costs

The following is a summary of the costs for scouting in Idaho in 1931:

Salaries.....	$711.66
Expenses.....	399.37
Total.....	$1,111.03

NORTHEASTERN WASHINGTON

A. Location of Work

The eastern portion of the Colville National Forest and adjacent areas in both the United States and Canada were scouted in September. This area lies between Curlew Creek and the Sanpoil River on the west and the Columbia River on the east. It includes the Kettle Range where on several of the peaks between 6,000 and 7,000 feet elevation occurs Pinus albicaulis in association with R. viscosissimum, R. lacustre and R. cereum. At the lower elevations P. monticola occurs associated with R. petiolare, R. inerme, R. viscosissimum and R. lacustre.

B. Results

Although infection on the Ribes was found at 13 points in the United States and two in Canada, no pine infection was found. Details of the Ribes infections found are shown in Table No. 4.

TABLE NO. 4

RIBES INFECTIONS LOCATED IN NORTHEASTERN WASHINGTON, 1931

Location	Township	Range	Section	Ribes Species	Number Examined	Number Infected	Per Cent Leaves Infected	Distance to Pines	Pine Species	Number Examined
Ryan Creek at Columbia River	38N	39E	7	R. petiolare R. lacustre	50 15	2 0	10 0	5 miles		
Pierre Creek at mouth Fisher Creek	40N	37E	33	R. petiolare R. lacustre R. cereum	12 6 2	4 0 0	5 0 0	1,000 ft. 1,000 ft. 1/2 miles	P. monticola	3
Pierre Creek at road crossing	40N	37E	32	R. petiolare R. lacustre R. viscosissimum R. inerme	25 10 5 25	2 0 0 0	1 0 0 0	3-4 miles		
Sand Creek at road crossing	40N	37E	31	R. petiolare R. lacustre R. viscosissimum R. inerme R. cereum	25 10 5 25 5	4 1 0 0 0	1 .1 0 0 0	3-4 miles		
South Fork Sanpoil River	36N	34E	6	R. petiolare R. lacustre R. inerme R. cereum	25 3 3 2	2 0 0 0	.2 0 0 0	?		
South Fork Sanpoil River	36N	34E	9	R. petiolare R. lacustre R. inerme	25 3 3	2 0 0	.2 0 0	?		
North Fork Obrien Creek	36N	34E	23	R. petiolare R. lacustre R. inerme	30 4 4	2 0 0	.2 0 0	?		
At mouth North Fork Obrien Creek	36N	33E	26	R. petiolare R. lacustre	12 5	3 0	1 0	6 miles		
North Fork Sherman Creek	37N	35E	30	R. petiolare	50	1	2 leaves	2-1/2 miles		
East Deer Creek near Orient	39N	36E	22	R. petiolare R. lacustre R. viscosissimum R. inerme	6 5 7 5	1 0 0 0	2 0 0 0	?		
East Deer Creek near Orient	39N	36E	26	R. petiolare R. lacustre R. viscosissimum R. inerme	6 5 7 5	3 1 1 0	2 .05 .1 0	?		
West Deer Creek near Curlew	39N	34E	14	R. petiolare R. lacustre	25 10	1 0	2 0	?		
West Deer Creek near Curlew	39N	34E	24	R. petiolare R. lacustre	25 10	1 1	2 .1	?		
North Fork Deep Creek 8 miles from Cascade, British Columbia	41N	37E	?	R. petiolare R. lacustre	1 20	1 0	5 0	300 ft.	P. monticola	50
Lake Christina, Cascade, British Columbia	41N	36E	?	R. nigrum R. inerme	1 20	1 0	10 0	1/4 mile	P. monticola	30

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C. Costs

The costs for scouting in Washington in 1931 are as follows:

Salaries.....	$923.33
Expenses.....	155.00
Total.....	$1,026.60

SUMMARY OF SCOUTING IN THE INLAND EMPIRE

Previous to 1931 it had been determined that the disease was scattered over practically the entire white pine region but occurred in greatest abundance in the southern portion coincidental with the occurrence of R. petiolare. Scouting in 1931 revealed additional evidence in support of this.

There are now a total of 61 known pine infection centers in the Inland Empire. Eleven of these originated probably in 1923 which is believed to be the first year the disease invaded this region.

Of the 60 known centers in Idaho, 85 per cent were started probably by R. petiolare. Although species other than R. petiolare have not been responsible for introducing the disease at many points, they represent a serious menace to adjacent pines when blister rust is already established in the vicinity.

Scouting in Idaho outside the R. petiolare belt did not result in the location of infection. In northeastern Washington and adjacent British Columbia 15 centers of Ribes infection were located. All but one of these were found on R. petiolare and associated species, the exception occurring on R. nigrum in British Columbia.

BLISTER RUST CONTROL WORK IN WASHINGTON
1931

Blister rust control activities in Washington were continued as a cooperative project between the Bureau of Plant Industry and the Washington State Department of Agriculture. There is given below the amendment to the basic memorandum of understanding, which was drawn up to cover the cooperative work for the fiscal year 1932 beginning July 1, 1931:

AMENDMENT TO
MEMORANDUM OF UNDERSTANDING
Effective July 1, 1927

Between

THE UNITED STATES DEPARTMENT OF AGRICULTURE, BUREAU OF PLANT INDUSTRY
and the
WASHINGTON STATE DEPARTMENT OF AGRICULTURE.

Cooperative work in Controlling White Pine Blister Rust in
WASHINGTON

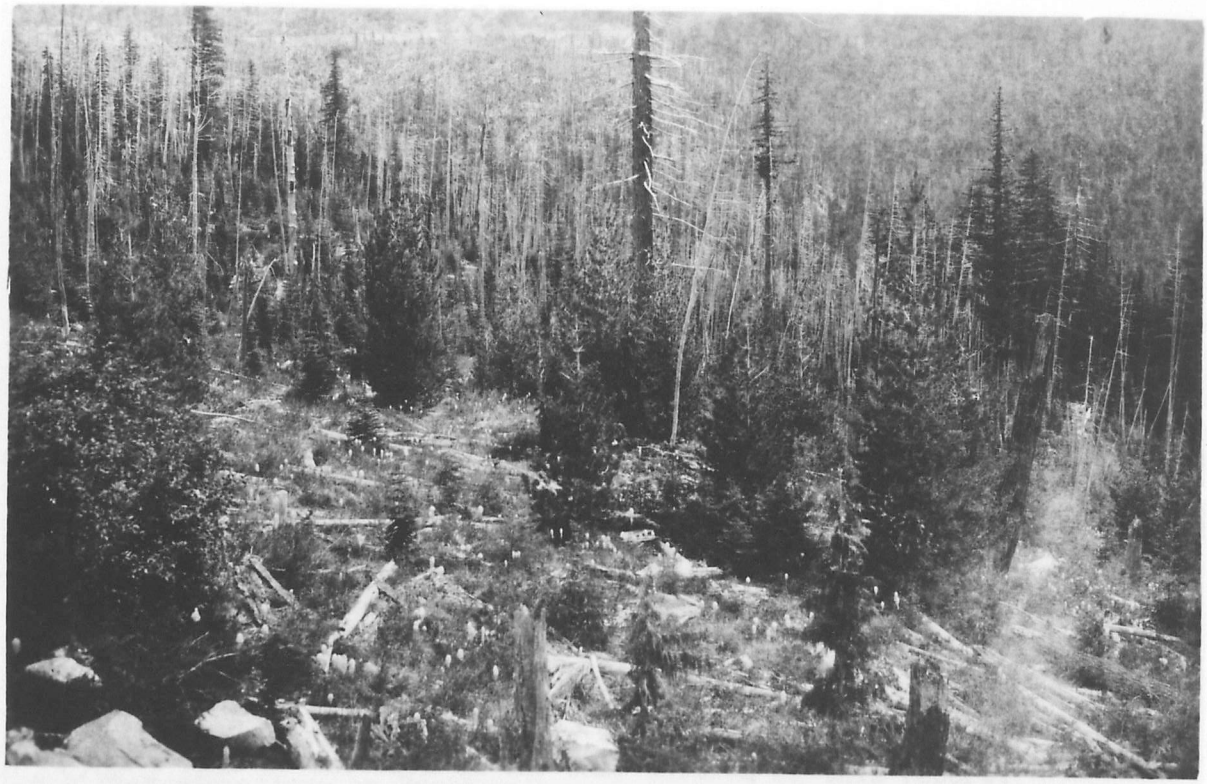
* * * *

Paragraph C-6, of the Memorandum of Understanding described above contains the following:

> "For the Fiscal Year 1928, the Bureau of Plant Industry shall contribute in value approximately $13,000 to the support of this cooperative work, and the Washington State Department of Agriculture shall contribute in value approximately $8,000.00; thereafter the amount to be contributed by each shall be determined and agreed upon by supplemental correspondence."

In accordance with the foregoing provision, it is mutually agreed that for the fiscal year ending June 30, 1932 there will be contributed in value by the Washington State Department of Agriculture approximately $4,000.00, and by the United States Department of Agriculture, Bureau of Plant Industry, through its Division of Blister Rust Control approximately $7,000.00 in connection with cooperative blister rust control work in Washington.

DATE:	Signature:
9/24/31	(s) Erle J. Barnes Director, Washington State Department of Agriculture
10/2/31	(s) Wm. A. Taylor Chief, Bureau of Plant Industry



W. 903. Silver Forest, showing western white pine. Elevation 4200 feet. R. acerifolium, R. lacustre and R. laxiflorum in medium abundance, with a majority of the bushes being very large. R. bracteosum very heavy along streams.



W. 904. Sunrise Park, showing distribution of both erect and prostrate forms of white bark pine. Elevation 6200 feet. R. acerifolium and R. viscosissimum scattered over this area. Initial Ribes eradication performed in 1931. Although not of commercial value white bark pine constitutes much of the timber present, in some cases being the only species in a group of trees.

BLISTER RUST ACTIVITIES, MOUNT RAINER NATIONAL PARK

By
M. C. Riley
Junior Forester

INTRODUCTION

Actual control activities were initiated on Mount Rainier National Park during the 1930 field season and took the form of Ribes eradication on the Longmire area and a preeradication survey on five other areas. These activities were the subject of the 1930 annual report.

The program carried on during the 1931 field season consisted of Ribes eradication, checking of Ribes eradication work, a reconnaissance survey, a preeradication survwy, scouting for white pine blister rust and some miscellaneous studies. Due to the close relationship between Ribes eradication and the checking of this work, discussion of both of these activities will be included in the same portion of this report.

The Division of Blister Rust Control supplied the necessary general supervision for all of these activities and in addition supplied the twine used on the Ribes eradication job and paid the salary and expenses of one man on the reconnaissance survwy,

RIBES ERADICATION

Purpose of the Work

The purpose of this portion of the program was to complete the eradication of Ribes over an area sufficient to insure protection to the designated white pine stands on the basis of what is now known regarding the width of protection zone necessary.

Location and Descriotion of Areas

Ribes eradication was performed on two definite areas during 1931. The amount of money allotted to this work for the year 1930 was not sufficient to finish the Longmire-Silver Forest area and consequently the first work of 1931 was to complete initial Ribes eradication on that unit. The location and description of this area was given in the 1930 annual report.

The second unit upon which initial Ribes eradication was performed is known as the Sunrise Area. Previous reports referred to this as the

White River-Yakima Park Area but the name has since been officially changed to Sunrise Park. For the purposes of this report the stand of western white pine at the White River Public Camp is included in the Sunrise Area because Ribes eradication was performed in these stands of white pine at the same time.

The western white pine stand at the White River public Camp consists of approximately 20 acres and is practically pure, averaging about 60 years of age. There were very few Ribes in the stand itself and these were principally R. lacustre. The adjacent area which had to be worked to afford initial protection to the stand contained a medium concentration of R. lacustre, R. viscosissimum and R. acerifolium. The stream type along White River where R. lacustre and R. laxiflorum were abundant, presented very difficult working conditions.

In the major stand making up the Sunrise Area white bark pine occurs along the bench from Burroughs Mountain east to and including Sunrise Ridge. Western white pine 60-80 years of age extends along the slope on either side of the highway from a point about one-half mile east of the White River bridge until the type merges with the white bark pine at the higher elevations in Sunrise Park.

Ribes in Sunrise Park proper from Burroughs Mountain east to about one mile beyond the development were confined to isolated clumps along the rim on the north side and to a small area around Shadow Lake. From this point east to the eastern edge of the sub-alpine type the Ribes were more generally distributed over the territory and consisted principally of R. acerifolium, R. watsonianum and R. viscosissimum. The denser timber stands supported Ribes only along streams and moist draws. Stream type was encountered along White River and Yakima Creek with R. lacustre and R. laxiflorum the prevailing species. R. bracteosum was found only along White River below the mouth of Yakima Creek and in a small area on the east side of White River near the mouth of Shaw Creek. A wide belt bordering White River on the flats was generally classed as stream type. Moist and sometimes swampy conditions prevail on the flats and this results in heavy Ribes growth, especially R. lacustre.

Methods and Equipment

All of the Ribes eradication work on Mount Rainier National Park was done by the hand pulling method. On both of the areas worked in 1931 the 3-man crew was used with the exception of approximately 600 acres on the Sunrise area where a scout crew sufficed. Due to the scarcity of R. bracteosum on the Sunrise area it was generally necessary to work the

stream type for a distance of only one-quarter mile from the white pine stands. Where this species did occur, as was the case at the outer edge of the protection zone down White River from the white pine, the area was worked for an additional three-quarters of a mile, R. bracteosum only being removed.

This was the first year that any camp equipment had been necessary and it was all furnished by the Park Service.

Results of Work

The results of Ribes eradication on Mount Rainier National Park during the 1931 field season are tabulated as follows:

TABLE NO. 1

RIBES ERADICATION SUMMARY, MOUNT RAINIER NATIONAL PARK, 1931

Area	Eradication Type	Man Days	Acres	Total Ribes Pulled								Acreage Basis		
				R. brac.	R. lac.	R. lax.	R. acer.	R. vis.	R. wat.	R. sang.	Total	Ribes	Man Days	Cost
Longmire	Stream	95.2	23.8	9,678	2,454	161	25	-	-	-	12,318	517.6	4.00	$24.92
	Open Repro.	391.2	264.7	1,101	39,362	5,390	5,804	-	-	-	51,657	195.2	1.48	9.22
Totals or Averages		486.4	288.5	10,779	41,816	5,551	5,829	-	-	-	63,975	221.8	1.69	10.53
Sunrise	Stream	474.5	383.5	4,813	121,765	8,557	188	557	123	80	136,083	355.8	1.24	7.73
	Open Repro.	50.0	65.6	21	6,869	550	194	239	1,133	-	9,006	137.2	.76	4.73
	Open Pole	321.0	524.3	539	36,778	162	10,801	2,611	9,410	57	60,358	115.1	.61	3.80
	Open Mature	6.0	7.0	-	2,532	5	-	-	-	-	2,537	362.4	.86	5.36
Totals or Averages		851.5	980.4	5,373	167,944	9,274	11,183	3,407	10,666	137	207,984	212.1	.87	5.42
Grand Totals or Averages		1,337.9	1,268.9	16,152	209,760	14,825	17,012	3,407	10,666	137	271,959	214.3	1.05	$6.54

Aside from the acreage shown above, the Sunrise area had approximately 600 acres where the scouting method was used and approximately 800 acres which were blocked out as being free from Ribes. This gives a total of 2,668.9 acres furnished initial protection at an average cost of $3.12 per acre.

Checking

Temporary check strips were run on all areas where Ribes eradication was performed. These strips were run on the basis of a 2% check with results as shown in Table No. 2. The heading "Old" shows the amount of live stem which was missed during the first eradication and "New" is the amount of live stem which has appeared since Ribes eradication, being sprouts and seedlings.

TABLE NO. 2

RESULTS OF CHECKING, MOUNT RAINIER NATIONAL PARK, 1931

Area	Erad. Type	Live Stem Per Acre After First Eradication																				
		R. bracteosum			R. lacustre			R. laxiflorum			R. acerifolium			R. viscosissimum			R. watsonianum			Total		
		Old	New	Total	Old	New	Total	Old	New	Total	Old	New	Total	Old	New	Total	Old	New	Total	Old	New	Total
Long-mire	Stream	17.8	13.4	31.2	6.5	2.3	8.8	10.6	5.5	16.1	-	-	-	-	-	-	-	-	-	34.9	21.2	56.1
	Open Repro.	.3	-	.3	3.4	-	3.4	2.1	-	2.1	14.2	-	14.2	-	-	-	-	-	-	20.0	-	20.0
Sun-rise	Stream	12.3	-	12.3	26.0	-	26.0	17.9	-	17.9	-	-	-	.7	-	.7	-	-	-	56.9	-	56.9
	Open Repro.	-	-	-	36.9	-	36.9	-	-	-	-	-	-	-	-	-	-	-	-	36.9	-	36.9
	Open Pole	-	-	-	31.1	-	31.1	-	-	-	13.6	-	13.6	9.4	-	9.4	4.1	-	4.1	58.2	-	58.2

Only the stream type on the Longmire area shows any new live stem because this was the only area worked in 1930. No new live stem is shown for the other types due to the fact that the checking figures were taken so soon after initial Ribes eradication was performed that insufficient time had elapsed for the seedlings and sprouts to appear.

Cost Analysis

The following table shows the total cost of the Ribes eradication job:

TABLE NO. 3

STATEMENT OF COST OF OPERATION, MOUNT RAINIER NATIONAL PARK, 1931

Item of Expenditure		Cost	
		Per Item	Total
Salaries and wages	Supervision	$ 535.68	
	Temporary field men	6,623.13	$7,158.81*
Equipment	Total cost	1,053.16	
	Transportation	38.50	1,091.66
Miscellaneous	Twine	20.53	
	Operation of cars	68.82	89.35
Grand Total			$8,339.82

*Subsistence at 40¢ per meal is included in this item.

Funds expended by the Division of Blister Rust Control are represented by the items for supervision and twine. The proportionately high cost for equipment is caused by the necessity of charging all equipment to one year's operation.

REERADICATION

During the 1931 field season a small amount of reeradication was done consisting of 1.3 acres in the Narada Falls portion of the Longmire area. This originally had an exceptionally dense concentration of Ribes which were eradicated in 1930. Due to the location of the area it was deemed advisable to rework it in 1931 in view of the fact that many seedlings were appearing and that there were also some missed bushes and sprouts evident. During original eradication the number of bushes per acre was 490 R. lacustre, 2,517 R. bracteosum and 85 R. acerifolium.

The reeradication resulted in the removal of 396 R. bracteosum seedlings and 6 R. lacustre seedlings per acre, 108 R. bracteosum and 8 R. lacustre sprouts and 8 R. bracteosum and one R. lacustre missed bushes. This gives a total per acre feet of live stem of 136 R. bracteosum and 16 R. lacustre. The cost per acre of original Ribes eradication was $89.09 and the cost per acre of reeradication was $9.34

CONTROL RECONNAISSANCE

At a conference held at the office of the Park Superintendent at Longmire, Washington on June 27, 1931, and attended by representatives of the divisions of Blister Rust Control and Forest Pathology, Bureau of Plant Industry and the National Park Service, it was the opinion of those present that a Ribes and white pine survey of the Park was an immediate need which should be undertaken during the 1931 field season. Accordingly this work was undertaken on a cooperative basis, the National Park Service and the Division of Blister Rust Control each furnishing the salary of one man. The Park Service supplied the necessary equipment and packing, and the Division of Blister Rust Control supervised the work and compiled the data.

The purpose of this reconnaissance, which was conducted by two experienced field men, was to secure information upon the occurrence of white pine and of Ribes to permit the development of a general plan for blister rust control on Mount Rainier National Park.

The general forest type map as prepared by C. F. Brockman, Park Naturalist, was used as a basis for the field work which was confined to the areas designated on this map as the sub-alpine and timber-line types and to those areas which were included within the boundaries of the Park since the completion of the type maps. These types were used as representing the distribution of white bark pine in the Park and that portion of the distribution of western white pine in which it assumes major significance and which had not been previously examined.

The working method consisted of: (1) a general survey to determine areas containing white pine, and (2) a more intensive strip system to determine conditions on such areas. Much of the area being barren or of the open-park-like type where individual trees could be seen for a considerable distance, it was a comparatively simple matter to eliminate these areas from consideration. This portion of the work resolved itself into a very extensive reconnaissance. When areas were encountered which contained white pine or when it was impossible to determine tree species for any appreciable distance a more intensive strip system was used.

As a result of this reconnaissance there were 7,031 acres found which support white bark pine and 2,370 acres which support western white pine. A total of 85,000 acres was examined. Aside from the white pine mentioned above, a total of 7,365 acres of western white pine had previously been located.

Expenditures for this control reconnaissance by the Park Service amounted to $320.00 and expenditures by the Division of Blister Rust Control including compilation of maps and data, amounted to $598.00.

PREERADICATION SURVEY

During the course of the 1930 field season a preeradication survey was conducted by the Division of Blister Rust Control on certain designated white pine areas. Such a survey was also conducted during the 1931 field season. As in previous years no attempt was made to weigh the value of the white pine against the cost of protection so far as relative importance of the various areas was concerned.

With one exception the areas examined where among those located by the reconnaissance survey. This exception was the white pine stand on the Muddy Fork of the Cowlitz River, which was examined in 1930. Extension of the Park boundary enlarged the acreage of this stand within the Park and a reexamination was necessary.

Table No. 4 gives the results of the preeradication survey.

TABLE NO. 4

RESULTS OF THE PREERADICATION SURVEY, MOUNT RAINIER NATIONAL PARK, 1931

Area	Acres	Predominating White Pine Species	Estimated Cost First Ribes Eradication
Bear Park	300	P. albicaulis	$1,800.00
Burnt Park	375	"	720.00
Clover Lake-Huckleberry Park	2,840	"	14,500.00
Cold Basin	550	P. monticola	14,800.00
Crystal Mountain	2,420	"	19,950.00
Governor's Ridge	225	P.albicaulis	700.00
Muddy Fork Cowlitz	1,750	P.monticola	8,200.00
Seattle Park	125	P.albicaulis	200.00
Seymour Peak	1,096	"	5,432.00
Starbo Camp	420	P.monticola	1,800.00
Summerland	300	P.albicaulis	1,100.00
Typsoo Lake	520	"	3,060.00

SCOUTING

Scouting for white pine blister rust was conducted on Mount Rainier National Park both within and outside the boundaries. The scouting carried on within the Park consisted of a systematic covering of the white pine areas in Sunrise Park, Longmire-Silver Forest, the Muddy Fork of the Cowlitz River and areas where infection had previously been found. This was supplemented by the work of the reconnaissance crew who were constantly on the lookout for infection, and by men conducting the preeradication survey.

The only new infection center located is on the Muddy Fork of the Cowlitz River. Infection is generally scattered over approximately 1,750 acres and is present on both western white pine and Ribes. No fruiting cankers were found; those which were the most advanced were producing pycnia for the first time. No tree was found with more than six cankers per tree and it is estimated that only about one per cent of the trees in the stand were found to be infected.

In an effort to find infection centers outside the Park which might be considered as a future menace to white pine stands within the Park, scouting was carried on in several drainages outside the boundary. This scouting covered portions of the Nisqually River, Skate Creek, Butter Creek, Chanapecosh River, Carbon River, White River and Greenwater River. No infections were found.

MISCELLANEOUS STUDIES

A study was designed to show the development of blister rust on various species of Ribes at varying distances from individual heavily infected pine trees or small groups of trees. Using a heavily infected tree or group as a center, strips were run in the four cardinal directions and data were taken on the infection present on various Ribes species which might be chargeable to the particular tree or group. This study was conducted where the trees or groups were several chains apart, but no definite correlation could be established. As the strips progressed away from the center the intensity of infection would change at varying distances regardless of Ribes species and for no visible reason.

During the 1930 field season much R. bracteosum was removed from sites where sand and silt were continually deposited on the roots and crowns of the bushes. This continued depositing was due to daily high water caused by melting glaciers. It was impractical to remove all of the roots in these cases, but the portions of roots which remained were very small and were immediately covered with a new deposit of mud and silt.

An examination of these areas in 1931 failed to disclose any sprouting from the root portions left in the ground.

Studies were started in an attempt to determine the amount of Ribes roots which can be left in the ground without danger of sprouting. Insufficient time has elapsed to furnish definite results.

SUMMARY

During the 1931 field season Ribes eradication was performed on 1,268.9 acres at an average cost of $6.54 per acre. This resulted in initial protection being afforded to 2,668.9 acres at an average cost of $3.12 per acre. Checking was done on all areas where Ribes eradication had been performed. Reeradication on 1.3 acres resulted in removing a total of 152 feet of live stem per acre. A control reconnaissance survey covered 85,000 acres of which 7,031 acres supported white bark pine and 2,370 acres supported western white pine. A preeradication survey was conducted on twelve areas, of which eight areas had white bark pine and four had western white pine as the predominating species.

BLISTER RUST CONTROL WORK IN OREGON
1931

Blister rust control activities in Oregon were continued as a cooperative project between the Bureau of Plant Industry and the Bureau of Plant Industry of the State Department of Agriculture, the Oregon State Board of Forestry and Oregon State College. There is given below the amendment to the basic memorandum of understanding, which was drawn up to cover the cooperative work for the fiscal year 1932 beginning July 1, 1931:

1932 AMENDMENT TO
MEMORANDUM OF UNDERSTANDING
Effective July 1, 1927

Between

THE UNITED STATES DEPARTMENT OF AGRICULTURE, BUREAU OF PLANT INDUSTRY

and the
OREGON STATE BOARD OF HORTICULTURE - - - OREGON STATE BOARD OF FORESTRY - - - and the OREGON STATE COLLEGE

Cooperative Work in Controlling White Pine Blister Rust in

OREGON

* * *

Paragraph E-6 of the Memorandum of Understanding described above contains the following:

> "For the Fiscal Year 1928, the Bureau of Plant Industry shall contribute in value approximately $16,000 to the support of the cooperative work, and the Oregon State Board of Horticulture approximately $14,250, the Oregon State Board of Forestry approximately $7,000, and the Oregon Agricultural College shall contribute in value approximately $1,500; thereafter the amount to be contributed by each shall be determined and agreed upon by supplemental correspondence."

In accordance with the foregoing provision, it is mutually agreed that for the fiscal year ending June 30, 1932, there will be contributed in value by the Oregon State Board of Horticulture approximately $4,000, by the Oregon State Board of Forestry approximately $1,000, by the Oregon

State College approximately $1,750, and by the United States Department of Agriculture, Bureau of Plant Industry, through its Division of Blister Rust Control, approximately $7,500, in connection with cooperative blister rust control work in Oregon.

Date:	Signature:
Oct. 14, 1931	(s) Chas. A. Cole Director, Bureau of Plant Industry, State Dept.of Agriculture (succeeding State Board of Horticulture
Oct. 15, 1931	(s) Lynn F. Cronemiller State Forester, Oregon State Board of Forestry.
Oct. 13, 1931	(s) H P. Barss Plant Pathologist, Oregon State College.
Nov. 6, 1931	(s) Wm. A. Taylor Chief, Bureau of Plant Industry

In addition to the cooperative arrangements as expressed in the preceeding amendment, $500 was allotted by the Forest Service for use by this Division in carrying on the experimental control operations upon the Still Creek plantation area on the Mt. Hood National Forest.

BLISTER RUST CONTROL ACTIVITIES IN OREGON

By
L. N. Goodding
Associate Pathologist

Blister rust work in Oregon during 1931 consisted of reconnaissance work, Wind River Nursery sanitation, scouting for blister rust, preeradication survey of the Breitenbush planted area, the Ribes garden at Rhododendron and educational work.

CONTROL RECONNAISSANCE IN OREGON

Purpose

It was found that too little information was available on which to base ideas regarding the desirability of blister rust control in most parts of southern Oregon. For this reason it was thought advisable to conduct an extensive reconnaissance of the white and sugar pine areas of Oregon, but particularly of the sugar pine regions in the Cascades and the Siskiyou mountains. This work was not planned to constitute a preeradication survey. The purpose was not only to collect data in the field but also to gather information from whatever sources possible which might throw light on the abundance and value of white and sugar pine in different sections of these areas, together with Ribes conditions in these stands.

Sources of Information

Much data were compiled prior to the field season from a variety of sources. These sources were: (1) Forest Service records, estimates and cruises; (2) Oregon and California Railway Land Grant Cruises; (3) the Forest Economic Survey; (4) reconnaissance work in southern Oregon done by the Division of Blister Rust Control in 1925; (5) reconnaissance by the Division of Blister Rust Control in the Cascades in 1926; (6) general information gathered in connection with other types of blister rust work; (7) Sudworth's charts showing pine distribution; and (8) records in the office of the State Forester.

Plan of Operation

As more concrete information was at hand on the distribution and abundance of pine in the northern half of the state than in the southern, and as the crew was of necessity small, operations were planned to begin in the extreme southern part of the state and to extend north as far as possible. The state leader was in charge of the reconnaissance and was

assisted by four temporary men. The work started in the Oregon Caves section with Putnam and Chapman on the ground to instruct the reconnaissance crew. The responsibility for the choice of regions for general and intensive reconnaissance rested with the state leader, whose work was largely that of scouting the larger pine areas and eliminating territory on which pine growth was either nil or too low for consideration.

In land classification, four types were decided upon: (1) land with some white, sugar, or white bark pine present, but less than 1%, (2) land with 1-5%, (3) land with 5-20%, (4) anything over 20%. The percentages were determined by a count of trees on sample plots. The following discussion, however, considers regions in which the percentage of white and sugar pine B.M. is higher than the percentage based on the number of trees.

The first step in any region was general scouting in order to locate forest types and eliminate areas where pine is negligible. After this, strips were run at right angles to the section lines every mile in uniform stands (where the forest type does not change with the topography), otherwise at right angles to the forest strips as determined by the topography. The strip system was a slight modification of that originally suggested by Putnam, differing only in having the pine plots one chain square instead of circular plots with an area of one square chain. This square plot had the advantage of being easier to lay out. Data on this plot included total number of trees, white and sugar pine, and others. The trees in the stand were classified into the groups, 0-6 inches, 6-12 inches and over 12 inches D.B.H. The classification by diameter classes shows in each case the relative amount of the white pine that is of commercial value. After the pine data were taken on the square chain plots, a strip 1/4 chain wide was continued for four chains on which Ribes data were taken. After this, for five chains, no data were taken and then the process was repeated. It was seen early in the survey that it was impossible to run strip through each section, so the descriptions are based on the townships. Commonly not more than two strips were run through a township. Tables No. 1 and 2 list areas shown on the map. A discussion of each follows. The data were gathered from the township sheets prepared by the reconnaissance crew.

Description of White and Sugar Pine Areas

Many of the areas entered on the map in brown have excellent sugar pine of large dimension, in many places constituting a major part of the merchantable timber. But from the standpoint of percentage of trees or actual number of seedlings, and also young trees, these cannot be considered as warranting control work. Much of the territory in the Oregon Caves region of the Siskiyou Mountains falls into this class, and similarly

that in the block about Pinehurst. Ribes in the Oregon Caves region are abundant and preclude the possibility of extensive control at low cost. The Ribes in the Pinehurst region are less abundant except along rough draws and old burns where a form of R. sanguineum is plentiful. The area discussions follow:

A. Jenny Creek Area

T. 38 S., R. 5 E.; T. 39 S., R. 4, 5E. - 18,160 acres.
Yellow pine-sugar pine type; sugar pine 8%.
Ribes: R. sanguineum, R. binominatum and R. lacustre; 15 per acre.

This is a small part of the Pinehurst area, with a relatively high percentage of sugar pine. Plot studies showed few Ribes, R. sanguineum, R. binominatum and R. lacustre being the only species. The forest type (sugar pine-yellow pine) and general region, however, indicate R. cereum and R. hallii are likely to be found in some abundance. It is possible that this should be considered as a control area.

B. Big Elk-Dead Indian Road Area.

T. 36 S., R. 4 E.; T. 37 S., R. 4, 5 E.; T. 38 S , R. 4, 5 E. - 26,120 acres.
White pine-white fir type; western white pine 20%.
Ribes: R. hallii and R. lacustre; 120 bushes per acre.

This is a poor site for white pine. The land is volcanic and for the most part rocky. The timber is scrubby and limby. While 20% of the stand is western white pine, the grade of the timber, the facts that it seems to be giving place to the more tolerant white fir and that Ribes are abundant, suggest that it is inadvisable to undertake its protection.

C. Mt. McLoughlin Area

T. 36 S., R. 4 E., 2,880 acres.
Pinus albicaulis type; P. albicaulis 80-90%.
Ribes: none.

The Mt. McLoughlin area is near Four Mile Lake and on the slope of Mt. McLoughlin. It may be expected to become of importance from a recreational standpoint. Approximately 3,000 acres run 80% of Pinus albicaulis. There is a very little western white pine along the lower edge. All this region being pumice soil or lava rocks, there are no streams, and as far as strip studies revealed, there are no Ribes, although further study may show some. At any rate, this area could be protected at very low cost.

D. Rustler Peak Area

T. 34 S., R. 3, 4 E., 4,720 acres.
White pine-white fir and yellow pine-sugar pine types; western white and sugar pine 19%.
Ribes: R. lobbii, R. hallii, R. sanguineum and R. lacustre; 31 per acre.

Nearly 5,000 acres in this region warrant further investigation. The higher west-facing slopes bear timber of the white pine-white fir type, running 19% of the former, while on the more level land below the timber is of the sugar pine-yellow pine type, running 19% sugar pine. Between there is a gradual transition from one type to the other. Field notes indicate a rather low amount of reproduction and a good stand of mature timber.

E. Rogue River Drainage Area

About 144,000 acres in this drainage constitute the most important white and sugar pine region in the state. The southern part is a sugar pine-Douglas fir type. The sugar pine is mostly mature and of very large size, but there is ample reproduction. The upper portion is western white pine-Douglas fir type. For convenience, these two portions will be discussed separately.

F. Lower Rogue River area

T. 32 S., R. 3 E.; T. 33 S., R. 2, 3 E; T. 34 S., R. 4 E., 87,440 acres.
Sugar pine-Douglas fir type; sugar pine 13%.
Ribes: R. sanguineum, R. lacustre; 26 bushes per acre.

Approximately 87,500 acres in this region are predominantly sugar pine-Douglas fir land. Most of it is privatdy owned, being in the Rogue River Timber Company's holdings. Considerable logging has been done. The Woodruff Meadows eradication area, which is in the Crater National Forest, is in the north end of this region. Conditions on it may be considered fairly representative of all the sugar pine type throughout the area, although the Ribes are probably slightly more abundant there than on much of the land south and east of Prospect, Oregon.

A conservative policy of logging and adequate fire control following should insure an ample stand of sugar pine in the future. Two very susceptible species of Ribes grow in this region; namely, R. sanguineum and R. cruentum. R. lacustre is also present.

G. Upper Rogue River Area

T. 29 S., R. 3, 4 E.; T. 32 S., R. 1, 2 E.; T. 31 S., R. 1-4 E.; T. 30 S., R. 3, 4 E., 56,280 acres.
White pine-Douglas fir type; western white pine 15%.
Ribes: R. lobbii, R. hallii and R. lacustre, 28 bushes per acre.

There is a gradual transition from the sugar pine-Douglas fir type of the Lower Rogue River area to the distinctly western white pine-Douglas fir type of the northern part. While most of this is a western white pine type, part of it has a rather low percentage of white pine, and in some places western white pine runs as high as 75% of the stand. The average for the entire 56,280-acre tract is 15%.

With any conservative policy of cutting in this region, a heavy stand of western white pine is almost certain to follow. The mature timber of this species is of good quality and no places were noted where Dendroctonus has made inroads. The chief insect enemy seems to be a plant louse. The damage from this insect on both western white and sugar pine trees of the sapling stage is quite heavy, but death is infrequent.

Ribes bracteosum was reported by Sipe and Goodding, but was not found on any of the plots studied. It seems to be confined to a few of the streams at the very headwaters of the Rogue.

Initial costs of eradication in this region would probably be comparable to the figures for the Woodruff Meadows area. These ran a little over $2.00 per acre. It is doubtful whether chemical eradication would be feasible, as there are few concentrations of Ribes.

H. Yawkey Tract

T. 32 S., R. 7½ E., 4,680 acres.
Sugar pine-yellow pine type; sugar pine 10%.
Ribes: (This data obtained through the timber company, no Ribes data taken.)

The data obtained on this tract were supplied by H. Baun of Fort Klamath who is agent for the Yawkey Estate to which the property belongs.

According to Mr. Baun, the area should require nothing more than the attention of a scout crew, as there are few Ribes, if any.

I. Southeast Crater Park Area

T. 31 S., R. 6-7½ E.; T. 32 S., R. 6-7½ E., 2,370 acres.
White fir-white pine type; western white pine 19%.
Ribes: R. cereum, R. hallii and R. lacustre, 30 bushes per acre.

This region was burned over 15 or 20 years ago and has come up to western white pine and lodgepole pine. The entire area is spotty, some parts being mostly lodgepole and others 50-60% western white pine.

The timber is not of commercial size at present, but the area deserves attention because of the excellent western white pine young growth.

J. Dutton Ridge Area

T. 31 S., R. 6-7½ E., 1,440 acres.
White fir-white pine type; western white pine 38%.
Ribes: None.

Should this area be considered for blister rust control, it should be combined with some of the territory close to the Crater rim where there is a good stand of white bark pine. The chief reason for giving this region consideratinn is that it is traversed by the Crater Rim Road and has scenic value. The timber, consisting of white pine and white fir, is scanty on the northwest slopes but heavy on the southeast slope which runs to Sand Creek. R. erythrocarpum is abundant along the Crater rim and R. cereum was found on Wheeler Creek. Strips run on this tract showed no Ribes.

K. Swede Basin Area

T. 37 S., R. 9 W.; T. 36 S., R. 8 W.; T. 37 S., R. 8 W., 3,300 acres.
Douglas fir-sugar pine type; sugar pine 28%.
Ribes: none.

The Swede Basin region has been quite extensively logged. Formerly it contained some of the finest sugar pine in Oregon. A remnant of this reamins in sections 13 and 14, township 37 south, range 9 west. Here reproduction is poor, the sugar pines ranging from 30 to 40 inches D.B.H. In the logged region to the north, indicated in brown on the map, sugar pine reproduction is scattered. Ribes were not found on any of the strips. Apparently this region offers itself to cheap protection. Doubtless some Ribes, R. cruentum for instance, will be found. A control area in this region should include much of the logged country to the north and east where reproduction is heavy in spots. It should also include the region shown on the map in green. The only Ribes noted in this additional territory were R. cruentum and R. nevadense, and these were sparse.

L. Bunker Hill Area

T. 34 S., R. 8, 9 W.; T. 35 S., R. 8, 9 W., 6,980 acres.
Yellow pine-sugar pine type; sugar pine 25%.
Ribes: none.

Some of the finest sugar pine in the state is in this area. While the site is not so good as that in the Lower Rogue River region near Prospect, there is a much higher percentage of sugar pine and there are few Ribes in the region. About 7,000 acres here should be given early consideration as a control area. The region can be reached by a very narrow road to the Bunker Hill mine.

M. Big Camas Area

T. 27 S., R. 3 E., 1,640 acres.
White pine-Douglas fir type; 12% western white pine.
Ribes: R. lobbii, and R. lacustre; 13 bushes per acre.

This area in itself is too small for consideration from a Ribes eradication standpoint, and while the territory proper shows few Ribes much of the adjacent region has an abundance, particularly of R. cereum. Throughout this section there is excellent western white pine of large dimension, but it is very scattering.

N. Bohemia Mt. area

T. 23 S., R. 1, 2 E., 3,040 acres.
Sugar pine-white pine-Douglas fir type; western white and sugar pine 16%.
Ribes: none.

There is a rather extensive area in this region on which both western white and sugar pine are excellent. It is possible from the paucity of Ribes indicated by the survey that an area much larger than 3,040 acres has sufficient pine to warrant protection at the very low cost which would be required to perform Ribes eradication. This report of no Ribes cannot be taken too seriously, however, as Ribes are always present in some of the out-of-the-way corners. While the plots showed no Ribes, the report on the entire township shows R. lacustre and R. nevadense abundant (there is doubtless R. sanguineum) and R. binominatum and R. cruentum frequent.

O. Marten Creek Area

T. 22 S., R. 1 E., 1,480 acres.
Sugar pine-Douglas fir type; sugar pine 32%.
Ribes: none.

This is similar to the last in both pine and Ribes conditions, and should doubtless be blocked in with it in any protection program.

From all reports this is one of the finest areas of sugar pine in the state. Its very limited extent is all tha precludes it from first consideration.

P. Crescent, Odell and Waldo Lakes

Extensive areas in the neighborhood of these lakes have excellent western white pine, but the percentage is low except for small patches. There seem to be no areas warranting attention from the control standpoint. Fortunately most of these stands are practically Ribes-free, and are likely to remain so until they have been logged or burned.

Q. The Cascades North of Waldo Lake

The reconnaissance of this region was very general, but more first-hand information from previous scouting was avilable. Western white pine is very generally distributed, and in many places is of excellent quality. The largest areas are not A-1 sites for pine, and Dendroctonus beetle work is extensive. Before any consideration of these areas from the standpoint of blister rust can be made, other protective work should be done. If the pine is ever considered of value commercially or for recreational purposes protection from fire, beetles and blister rust must go hand in hand.

Several places should receive attention in the near future, however. Of most importance among these are: (1) the Still Creek area on which Ribes eradication should be completed (see Still Creek report), (2) the Breitenbush planting (see preeradication survey report), (3) the region about Government Camp (see 1930 annual report), and (4) the white bark pine in the Cloud Cap Inn region on Mt. Hood. The last two are recreational areas.

Summary and Analysis

Table No. 2 indicates that there are 240,770 acres in the south end of the Cascades south of township 21 having more than 5% white pine. Of this, 38,370 acres have 20% or more, and 202,400 acres less than 20% but more than 5%. It is not possible to give accurate estimates of acreage by species. The Mt. McLoughlin area, however, is all white bark pine and is the only one of this species reported. The Jenny Creek, half of the Rustler Peak, the Lower Rogue River, the Yawkey Tract, the Swede Basin, the Bunker Hill, the Bohemia Mountain, and the Marten Creek areas are predominantly sugar pine. This gives an acreage for sugar pine of 138,560 acres. The Big Elk-Dead Indian Road, half of the Rustler Peak, the Upper Rogue, the Southeast Crater Park, the Dutton Ridge, and the Big Camas areas are predominantly

western white pine. This gives an acreage of 99,330 acres.

Besides the areas colored green or red on the map, there are approximately 400,000 acres south of township 21 classed as 1-5%. This includes much very fine but scattering sugar pine, and many strips of western white pine in the Cascades which run a much higher percentage but which are very small in extent.

Cost of Reconnaissance

These costs cannot consistently be placed on an acreage basis, as there was much of the work that was too extensive. Four men were employed during the summer, and the total expenditure for the project, including overhead, was $3,399.88.

Acreage of white pine over 5%.....	240,770
Acreage of white pine from 1-5%.....	400,000
Total.....	640,770

If all the costs are applied to the 640,770 acres, the cost per acre is $.0053. If all the costs are applied to the better pine land, the 240,770 acres, the cost per acre is $.014.

TABLE NO. 1

Costs of Control Reconnaissance
in Oregon

Item	Amount
Supervision and Labor	
Supervisor's salary and expenses	$1,412.07
Salaries of assistants	1,141.67
Subsistence	
Cost of food	234.50
Transportation of men	611.64
Total	$3,399.88

TABLE NO. 2

RECONNAISSANCE OF AREAS HAVING FIVE PER CENT OR MORE OF WHITE PINE

PINES

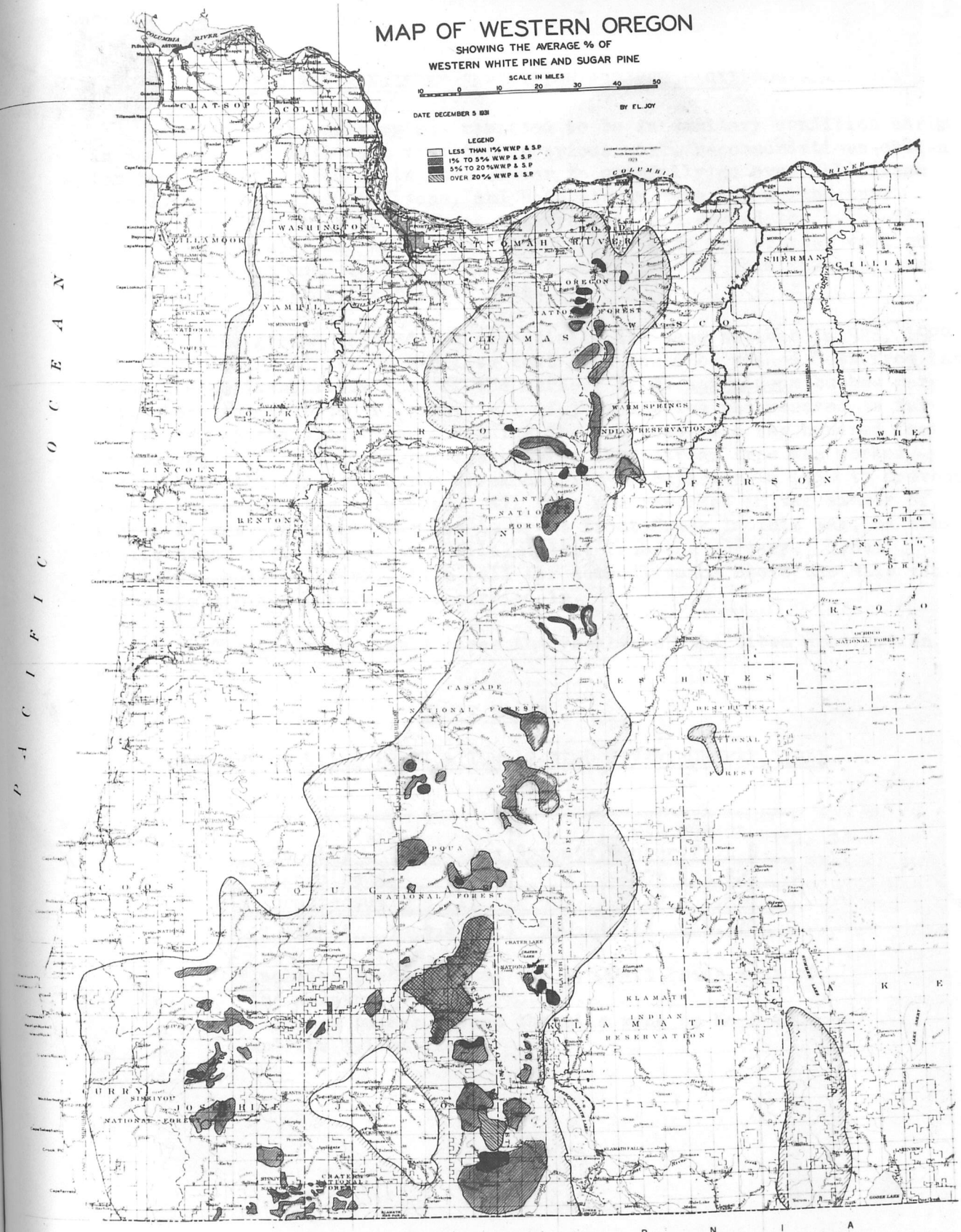
Area	Acres	Timber Type	Number of White Pine or Sugar Pine Per Acre				Per Cent of White Pine or Sugar Pine Trees	Approximate Per Cent White Pine or Sugar Pine Board Measure
			0-6 Per Cent	6-12 Per Cent	Over 12 Per Cent	Total		
Jenny Creek, T. 38 S., R. 4,5 E.; T. 39 S., R. 4,5 E.	18,160	Yellow Pine Sugar Pine	21	6	7	34	8	25
*Big Elk and Dead Indian Road, T. 36 S., R. 4 E.; T. 37 S., R. 4,5 E.; T. 38 S., R. 4,5 E.	26,120	White Pine White Fir	44	4	7	55	20	20
*Mt. McLoughlin, T. 36 S., R. 4 E.	2,880	Pinus albicaulis	Above 6,000 feet 80-90 Per Cent, the Rest Tsuga mertensiana.				Pinus albicaulis	
*Rustler Peak, T. 34 S., R. 3,4 E.	4,720	White Pine Sugar Pine White Fir Yellow Pine	43	2	5	50	19	20-25
Lower Rogue River, T. 32 S., R. 3 E.; T. 33 S., R. 2,3 E.; T. 34 S., R. 4 E.	87,440	Sugar Pine Douglas Fir	70	1	15	88	13	40
*Upper Rogue River, T. 29 S., R. 3,4 E.; T. 32 S., R. 1,2 E.; T. 31 S., R. 1,2,3, 4 E.; T. 30 S., R. 3,4 E.	56,280	White Pine Douglas Fir	96	5	16	117	15	15
Yawkey Tract, T. 32 S., R. 7-1/2 E.	4,680	Yellow Pine Sugar Pine	Not cruised. Data from protection agent, H. Baun.				10	40
*Southeast Crater Park, T. 31 S., R. 6-7-1/2 E.; T. 32 S., R. 6-7-1/2 E.	2,370	White Fir White Pine	52	5	8	65	19	10
*Dutton Ridge, Crater Park, T. 31 S., R. 6-7-1/2 E.	1,440	White Fir White Pine	67	12	12	91	38	25
*Swede Basin, T. 37 S., R. 9 W.; T. 36 S. R. 8 W.; T. 37 S., R. 8 W.	3,300	Douglas Fir Sugar Pine	10	1	14	25	28	40
*Bunker Hill, T. 34 S., R. 8,9 W.; T. 35 S., R. 8,9 W.	6,980	Yellow Pine Sugar Pine	22	1	8	31	25	40
Big Camas, T. 27 S., R. 3 E.	1,640	White Pine Douglas Fir	31	1	5	37	12	
*Bohemia Mountain, T. 23 S., R. 1,2 E.	3,040	Sugar Pine White Pine Douglas Fir	21	2	6	29	16	20
*Marten Creek, T. 22 S., R. 1 E.	1,480	Sugar Pine Douglas Fir	78	2	12	92	32	50
Total	~~240,770~~ 220,530							

RIBES

Area	Ribes Per Acre								
	R. lobbii	R. bracteosum	R. cereum	R. nevadense	R. hallii	R. sanguineum	R. binominatum	R. lacustre	Total
Jenny Creek						8	3	4	15
Big Elk and Dead Indian Road					100		Scattering	20	120
Mt. McLoughlin	No Ribes found on this area								
Rustler Peak	10				14	3		4	31
Lower Rogue River						13		13	26
Upper Rogue River	3				17			8	28
Yawkey Tract	No Ribes observed here. R. cereum abundant on adjacent areas.								
Southeast Crater Park			25		1			4	30
Dutton Ridge, Crater Park	No Ribes on plots. A few R. cereum found along the creek.								
Swede Basin	None found. R. cruentum found in adjacent territory.								
Bunker Hill	None on plots. A few scattering Ribes in the area.								
Big Camas	3							10	13
Bohemia Mountain	No Ribes found on this area.								
Marten Creek	No Ribes found on this area.								

*Areas bearing 15% stands of white pine.

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MAP OF WESTERN OREGON
SHOWING THE AVERAGE % OF
WESTERN WHITE PINE AND SUGAR PINE
SCALE IN MILES
10 0 10 20 30 40 50
DATE DECEMBER 5 1931
BY F.L. JOY
LEGEND
LESS THAN 1% WWP & S.P
1% TO 5% WWP & S.P
5% TO 20% WWP & S.P
OVER 20% WWP & S.P
COLUMBIA RIVER
ASTORIA
CLATSOP
COLUMBIA
WASHINGTON
TILLAMOOK
KLAMATH
OREGON
SHERMAN
GILLIAM
WASCO
YAMHILL
CLACKAMAS
MARION
WARM SPRINGS INDIAN RESERVATION
LINCOLN
JEFFERSON
BENTON
CASCADE NATIONAL FOREST
DESCHUTES
CROOK
LAKE
LANE
DOUGLAS
COOS
CURRY
SISKIYOU NATIONAL FOREST
CRATER LAKE NATIONAL PARK
KLAMATH INDIAN RESERVATION
KLAMATH FALLS
LAKEVIEW
PACIFIC OCEAN
CALIFORNIA

WIND RIVER NURSERY SANITATION PROJECT, 1931

While the nursery was reported to be in sanitary condition early in the spring of 1931 as a result of previous work, recommendations called for two men to be used during the summer to carefully go over all stream type areas within the mile zone, and both stream type and upland type within the 1,500-ft. zone. (These measurements are beyond the 1,160-ft. area of the Nursery and Arboretum.) Accordingly, two men started work on June 16 and continued to September 5. A small part of this time, however, was spent in scouting for blister rust.

The ground covered was essentially the same as that in1928, 1929 and 1930. Owing to the probability that seed would be washed down from the steep slopes immediately west of the nursery if R. sanguineum bushes were left close to the 1,500-ft. zone, all of this species was removed as far as the top of the slope thus extending the eradication a few hundred feet at this point. It will be remembered also that stream type was worked beyond the mile zone on Martha Creek and its tributaries in 1930 to prevent seed washing into the mile zone. All this was reworked in the summer of 1931. It was not found feasible to treat Trout Creek in this way, as some of its headwaters rise several miles distant from the nursery. Trout Creek has, however, very little fall for some distance above the mile zone, and seeds are not likely to be carried in.

The following table gives the results of the Ribes eradication work:

TABLE NO. 3

SUMMARY OF RIBES ERADICATION AT WIND RIVER NURSERY, 1931

Species	Seedlings	Sprouts	Old Bushes	
			Number	Ft.L.S.
R. sanguineum	0	0	290*	1,820
R. bracteosum	6,217	550	522#	1,550
Totals	6,217	550	812	3,370

*Includes bushes beyond the 1,500-ft. zone west of the nursery.

#Includes bushes beyond the mile zone on Martha Creek and its tributaries.

The following tables give the acreage, acreage costs and comparisons of stream and upland types:

TABLE NO. 4

COST OF RIBES ERADICATION

Type	Man Days			Total Man Days	Number Acres	Cost Per Acre	Total Cost
	June	July	Aug.				
Stream	4	36	52	92	190	$2.35	$446.57
Upland	26	26	10	62	186	1.60	297.70
Totals	30	62	62	154	376		$744.27

TABLE NO. 5

EXPENSES

Item	Amount
Day Labor	$515.66
Subsistence	188.20
Transportation*	18.09
Incidentals (twine, estimated freight charges, etc.)	22.32
Total	$744.27

*Travel was by government-owned truck. Expense calculated at 5¢ per mile. 320 miles. $2.09 railroad fare.

The region in the immediate vicinity of the nursery was quite thoroughly scouted for blister rust. The results show plainly that the rust is well distributed. A few years will prove definitely whether our sanitation is effective or not. The nearest pine infection located was about 2,000 feet from the nursery. No infection was found within the 1,500-foot zone. Reference to last year's report will show that infected pines were found six miles west of the nursery. Besides these, both pines and Ribes were found infected for two miles along Panther Creek three miles from the nursery, at the head of Martha Creek two miles southwest of the nursery, and on a small branch of Wind River one and one-half miles south of the nursery. The Ribes at the head of Martha Creek have now been removed. Infection on Ribes is no longer a significant matter in this region as it can be picked up practically any place outside the mile zone. The map shows two places where infection was found on currant bushes within the mile zone.

This indicates how vital complete Ribes eradication is to the sanitation of the nursery. In one case, a seedling was infected, and in the other a bush missed in previous eradications.

The following table gives the approximate cost of the one week of scouting done in this region.

TABLE NO. 6

COST OF SCOUTING

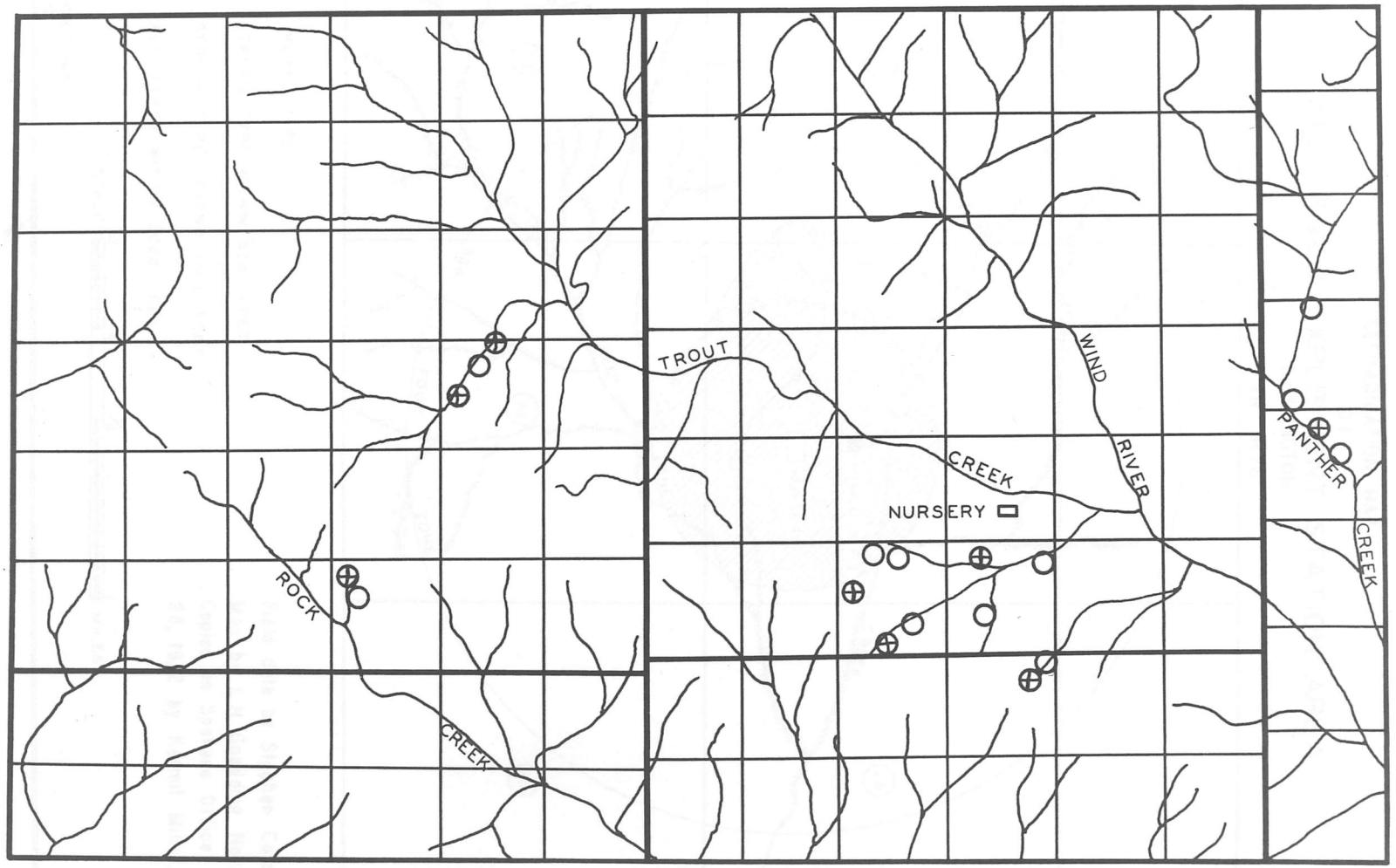
Item	Amount
Day labor	$28.30
Subsistence	12.00
Total	$50.30

Next season two men will be needed to go over the ground. The streams should be watched closely for seedlings and sprouts, and the steep hillside west of the nursery should be combed for missed bushes. In two or three more years, if no fires occur, the danger from upland Ribes in this region will be nil, for brush and trees are rapidly shading out smaller seedlings. Similarly, the Ribes flora along the streams will tend to become less significant. Two men for a month or a month and a half should be able to do all necessary eradication and scouting for blister rust in the 1,500-foot and mile zones.

BLISTER RUST INFECTION

WIND RIVER REGION

WASHINGTON



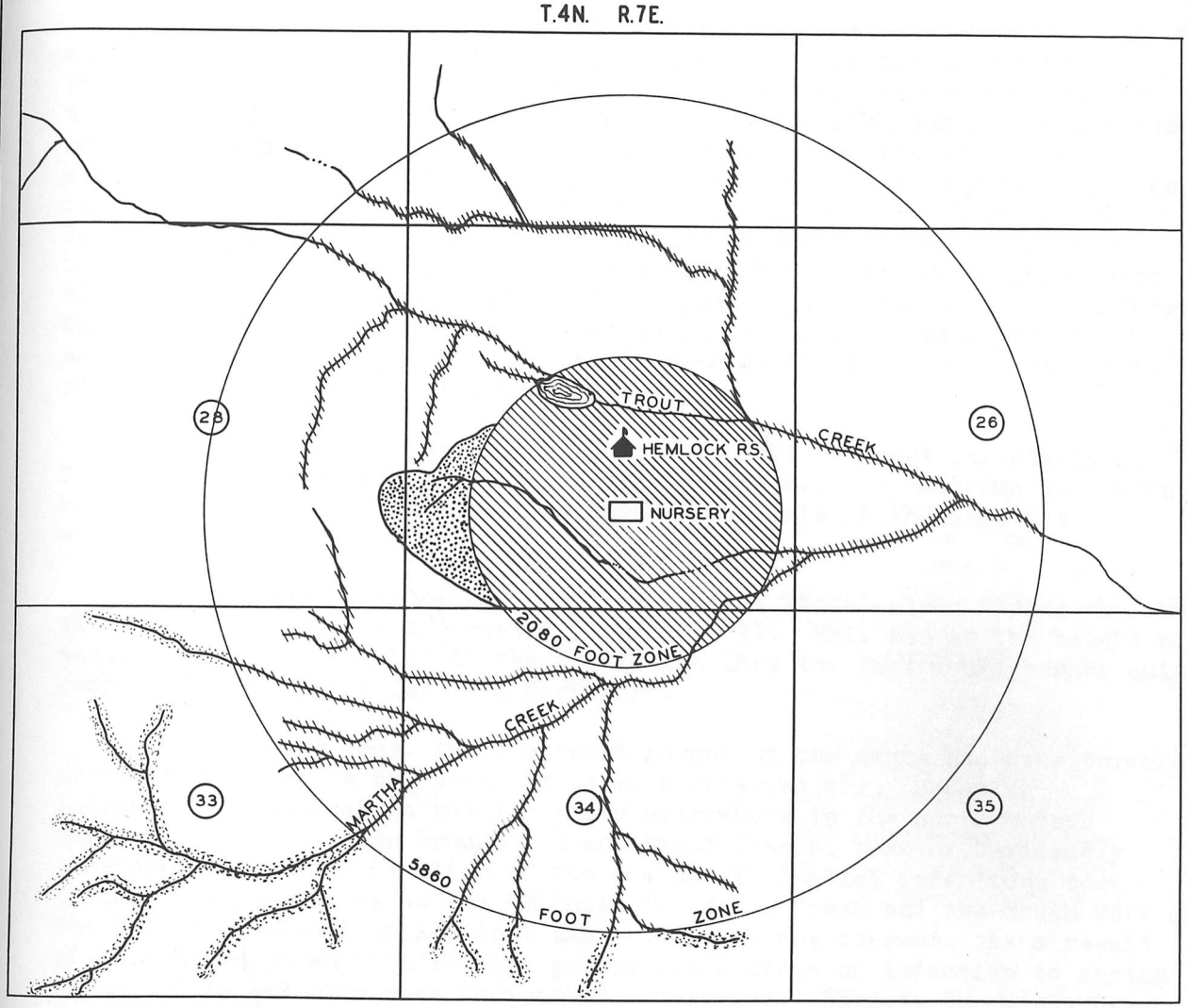
○ Ribes Infection
⊕ Pine Infection

Scale 1 ½ 0 1 2 3 Miles

MAP BY L.N. GOODDING AND STEPHEN COLEMAN NOV. 30, 1931. COPIED BY KERMIT MILLER MARCH 25, 1932.

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REERADICATION MAP
OF
WIND RIVER EXPERIMENT STATION AREA
WASHINGTON
T.4N. R.7E.



UPLAND TYPE

STREAM TYPE WITHIN 5860 FEET

STREAM TYPE BEYOND 5860 FEET

ALL TYPES WITHIN 2080 FEET

SCALE 0 1/4 1/2 1 MILES

Field data by Stephen Coleman.
Map by L.N. Goodding Nov. 1931.
Copied in Spokane Office March 28, 1932 by Kermit Miller.

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SCOUTING FOR BLISTER RUST IN OREGON, 1931

Most of the scouting for blister rust was done in connection with other work. That in the Cascades was accomplished at the same time as reconnaissance. The only scouting in eastern Oregon was peformed when a trip was made to collect fir seed. The Breitenbush-Hot Springs region was scouted in connection with a preeradication survey of the Breitenbush planting, and the Mt. Hebo section while a preliminary survey of conditions in the Mt. Hebo planting was being made. Special work was done in Del Norte County, California, and adjacent Curry County, Oregon. Scouting in Lane, Coos and Curry counties, extended back into the Coast Range east of Agness. While blister rust has been located at Humbug Mountain in Curry County two times, it is doubtful whether it has extended back into the sugar pine region. Blister rust was located on the Metolius in the same place where it was found two years ago.

Table No. 7 gives the location of blister rust infections on Ribes found this year. Other inspection points are too numerous to mention here. Some observations should be made as a result of the season's scouting.

Doctor Longley and Goodding were at Rhododendron during the severe wind and dust storm in the spring (April 21-23). This was at the height of aecial production and led to the prediction that the rust would become quite generally distributed for long distances.

During June, the northwest corner of the state had considerable precipitation, while the southern portion remained dry. Scouting indicated that infection was literally everywhere in the northwestern part of the state. The drought in southwest Oregon, however, evidently prevented any intensification of the disease if initial infections took place. The infections on the McKenzie (on Horse Creek and the South Fork of the McKenzie) also indicate that the prediction was correct. As a result of this storm we may confidently expect new centers of infection to spring up in remote and otherwise unexpected localities. Whereas the Minto Creek infection has apparently remained local for years, this storm has probably resulted in spreading aeciospores to many new localities. A similar unusual circumstance may have occasioned this same infection back in 1917 or 1918.

Scouting in the fall of 1930 and the spring of 1931 revealed that blister rust is established on pines in many places in the Still Creek planting. So general it is that careful scouting should be done during the season of 1932 with a view to removing all possible cankers. It is also of interest to note that two diseased Pinus albicaulis trees were found in this area, one by Putnam and the other by Chapman and Goodding, both on June 16, 1931.

The Minto Creek Infection Area

S. 14, T. 11 S., R. 7 E.

This appears to be the oldest infection in Oregon and has been the subject of a special investigation. The first infection in the Minto Creek region was located by Eldon Lyle, September 20, 1930. A very hasty examination of this area was made by Goodding and Lyle on October 11, 1930 at which time the age of the infection was determined as dating back to 1923 or earlier.

On May 14, N. N. Putnam, James Mielke, Doctor Longley and L. N. Goodding made a more careful examination of the area. The heavy infection is located at the base of a talus slope which skirts a west-facing lava bluff. The bluff itself is not extensive; a water course bounds it on the north side, and a shallow draw on the south. The heaviest part of the infection is south of the talus slope. None of the pines are mature, most of them are dominant, and as they stand in the open are limby to the base. Ribes sanguineum is rather abundant. Minto Creek is from three to five chains distant. R. bracteosum is very scattering along it, and the pines sparse. Infection on both pines and Ribes along Minto Creek is very light. The pine infection farthest from this center was along the trail about 1-1/2 miles toward Marion Lake. Mielke found a single incipient canker near the mouth of Pamelia Creek.

Two heavily infected trees were examined and the number of cankers estimated. The larger tree, 45 years old and 35 feet tall, had at least 500 cankers. Another tree, about 40 years old and 12 feet high, had 100 or more cankers. A careful analysis of the cankers on another tree gave the following results: one canker on 1913 wood, one 1914, 12 on 1918, 21 on 1919, 21 on 1920, 20 on 1921, 5 on 1922, 8 on 1923, 9 on 1924, 18 on 1925, 22 on 1926, and 2 on 1927 wood.

Examination of the area leads to the following estimates: (1) apparently the initial infection took place not later than 1917; (2) the waves of infection were in 1917, 1920, 1921, 1922, 1923, 1926 and 1927. Of these, 1921, 1922 and 1927 were heavy waves. (3) There were approximately 20 cankers of 1917 origin, 3,000 cankers of 1921-1922 origin, and 5,000 of 1927 origin in this center. (4) The infection is surprisingly local, all the infected pines are near R. sanguineum bushes, only an occasional pine 10 chains away from this center of infection shows disease.

The infection on R. sanguineum had just begun to show on May 14. Uredinia had in no case burst.

At the time this investigation was carried on scouting was done along Pamelia Creek and Pamelia Lake and on Minto Mountain. Later in the season the regions around Marion Lake, Pine Ridge and north of Big Meadows were examined. While the region to the south is mostly mature timber with poor Ribes association, there are excellent associations in the Pamelia Lake and Marion Lake regions with both R. bracteosum and R. lacustre. More careful and more extensive scouting must be done in this region. Unusual conditions, such as those occurring during the severe wind and dust storm in the early spring of 1931 may result in widespread infection.

The Mt. Hebo Infection Area

On August 19, 1931, Goodding scouted the Hebo planting for blister rust. This resulted in the location of 12 infected pines closely associated with R. bracteosum. A full discussion of this infection will be found in a letter to Mr. J. T. Kümmel of the Forest Service, a copy of which appears below:

(Letter to J. T. Kümmel of the Forest Service, Portland, Oregon, February 26, 1932.)

"Dear Mr. Kümmel:

"Up to the summer before last I entertained the conviction, founded on meagre scouting by Grasovsky and myself, that the Pinus strobus planting on Mt. Hebo was in no danger from blister rust. But a year ago last season Eldon Lyle informed me, after he had examined the area more carefully, that there was considerable Ribes bracteosum at the south edge of the planting and that we would likely find blister rust in the planting at an early date. On the 19th of last August I went to Mt. Hebo and took time to do more thorough scouting. I wish to give you some idea of my findings.

"I have made a rough sketch from one of your maps and numbered the streams I wish to discuss. Stream No. 1 is narrow above, and at the time I visited it was dry except for spots throughout perhaps half its length. R. bracteosum, in places only along the upper end, becomes much more abundant below. Near the east end of the planting the ground on either side is marshy and covered by a very dense growth of brush and alder. This condition holds for a considerable distance up stream No. 5, and the lower end of stream No. 2. Ribes in this brush and alder are quite general and are widely scattered. Stream No. 2 has lower brush, and masses of R. bracteosum. This condition extends up the stream for a comparatively short distance.

"I have tried to indicate these conditions by colors. The portion colored blue is heavy alder, that in green is dense brush with much R. bracteosum well exposed, and that in brown has scattering R. bracteosum well exposed and less brush.

"I was unable to locate upland Ribes in or about the planting.

"Along the portion marked brown, the R. bracteosum was heavily infected, and I located in all twelve infected pines. Most of these infections were on 1927 and 1928 wood. I removed all cankers found.

"None of the bushes in the heavy alder showed infection, and none of the pine adjacent to them were infected.

"It is evident that if the pines in this area are to be protected steps must be taken at once. In fact, there is certain to be considerable damage along stream No. 1 in spite of any control measures which may be carried out.

"Eradication is urgently necessary along stream No. 1 down to the dense alder, and in spite of the lack of infection in the portion shown in green this should be cleaned out because of its proximity to the pines. This could be done at slight expense. I doubt, however, that it is expedient to limit eradication to these areas. Eradication in the dense alders for 900 feet from the pines should be adequate. This will take in a portion of stream No. 5, stream No. 3 and a portion of stream No. 4. A 3-man crew could easily clean out the areas indicated by brown and green in one month. The approximate cost would be $500. The clean-up of the more extended area would require the work of the same crew for perhaps three months at a cost of $1,500. Considering that this is a very small area, the relative cost of which compared with large areas is always heavy, the job is inexpensive. Another point that should not be overlooked is that there are no native pines in this section to become diseased and produce a heavy intensification on the Ribes. For this reason, once the Ribes are cleaned out and the cankers occasioned by earlier infection removed from the trees, no heavy and extended infection on Ribes with the attendant danger of long distance spread will be possible.

"The examination I have made is hardly sufficient to constitute a preeradication survey, but is adequate to give us some concrete conceptions. If you contemplate protecting the area, I should like to examine more carefully streams No. 3 and No. 4."

TABLE NO. 7

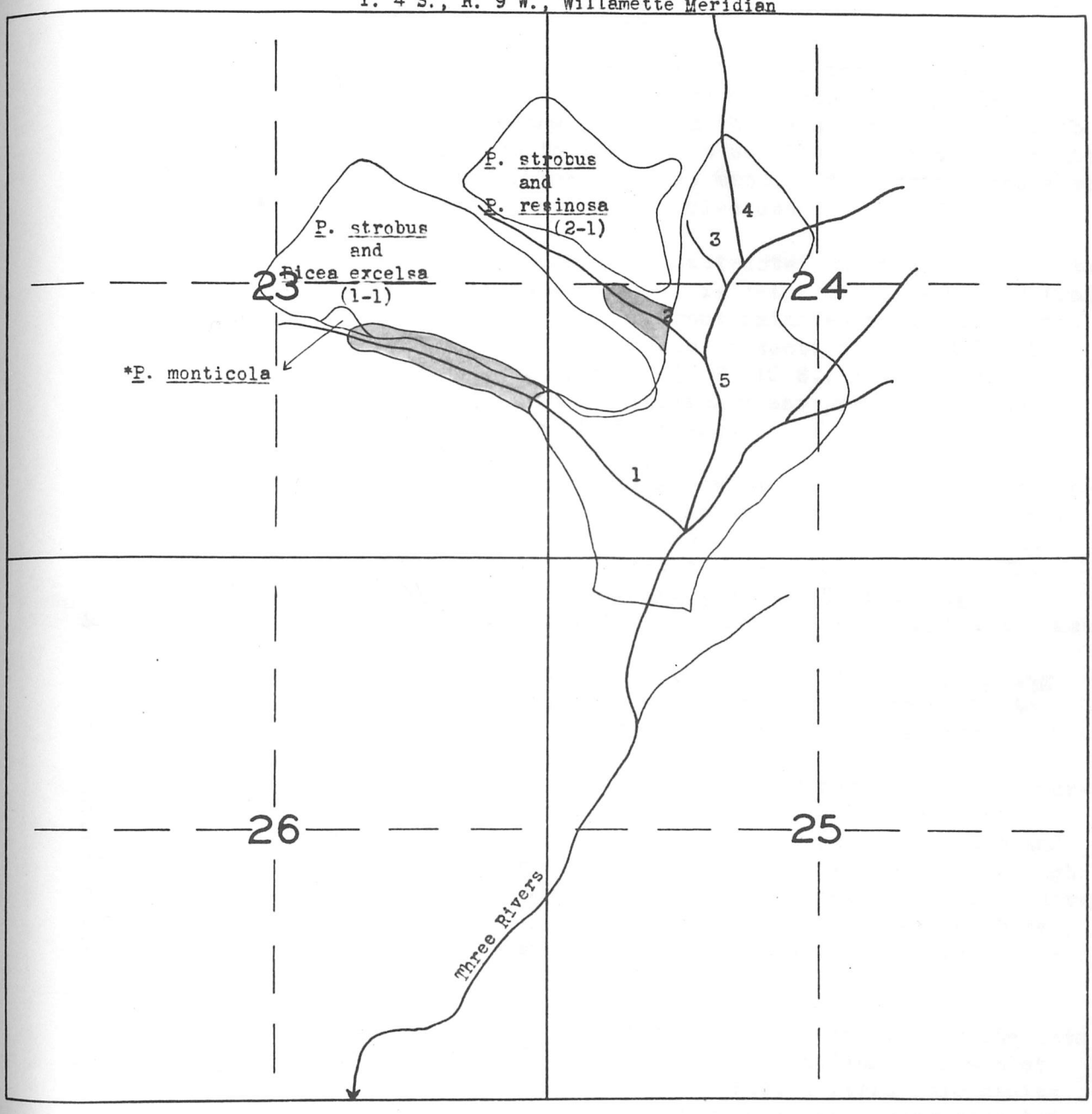
RECORD OF NEW BLISTER RUST INFECTIONS ON RIBES IN OREGON, 1931

Location, Willamette Meridian	Species Examined	Number of Bushes	Pine Association	Remarks	Inspectors	Date
Bear Springs Creek, Wasco County, Sec. 33. T. 5 S. R. 10 E.	R. petiolare	400	Poor	Very light but general	Goodding	7/25/31
Lost Creek, Lane County, Sec. 11. T. 16 S. R. 6 E.	R. bracteosum	50	Excellent	Intensity indicating near pine infection	Goodding	8/14/31
Horse Creek, Lane County, Sec. 27. T. 16 S. R. 6 E.	R. bracteosum	100	Poor		Goodding	8/15/31
Horse Creek, Lane County, Sec. 35. T. 16 S. R. 6 E.	R. bracteosum	100	Poor		Goodding	8/15/31
Mt. Hebo, Tillamook County, Sec. 23. T. 4 S. R. 9 W.	R. bracteosum	50	Excellent	Infected Pinus strobus nearby.	Goodding	8/19/31
The Couts Place, Tillamook County Sec. 25. T. 5 S. R. 9 W.	R. bracteosum R. sanguineum R. divaricatum	25	Good	Only one pine in the vicinity. Cultivated. Not infected.	Goodding	8/19/31
Summit, Benton County, Sec. 7. T. 11 S. R. 7 W.	R. bracteosum	12	None	Rather heavy intensification.	Goodding	8/20/31
South of Pacific City, Tillamook County. Sec. 7. T. 5 S. R. 10 W.	R. bracteosum	10	None	Rather heavy intensification.	Goodding	8/20/31
Neskowin, Tillamook County, Sec. 36. T. 5 S. R. 11 W.	R. bracteosum	25	None	Rather heavy intensification	Goodding	8/20/31
Pioneer Mountain, Lincoln County, Sec. 36. T. 10 S. R. 10 W.	R. bracteosum	5	None	Rather heavy intensification.	Goodding	8/20/31
South Fork McKenzie River, Lane County. Sec.3. T. 18 S. R. 5 E.	R. bracteosum	100	Very poor	Light infection.	Goodding	8/26/31
Elk Creek, Lane County, Sec. 30. T. 16 S. R. 4 E.	R. bracteosum	10	Poor	Light infection.	Goodding, Joy, Wheeler	9/1/31
Brush Creek, Curry County, Sec. 25. T. 33 S. R. 15 W.	R. bracteosum	50	None	Very light infection.	Goodding, Coleman	9/16/31
Crown Point, Multnomah County, Sec. 30. T. 1 N. R. 5 E.	R. bracteosum	25	None	Very light infection.	Goodding, Baker, Fracker, Stillinger	9/21/31
Fall City, Polk County, Sec. 17. T. 8 S. R. 6 W.	R. bracteosum	?	None	General infection.	Tiedemann	10/18/31
7 miles north of Siletz, Lincoln County. Sec. 6. T. 9 S. R. 10 W.	R. laxiflorum	?	None	Occasional in occurrence.	Hansbrough, Childs	8/12/31
12 miles north of Siletz, Lincoln County. T. 8 S. R. 10 W.	R. laxiflorum	?	None	Occasional in occurrence.	Hansbrough, Childs	8/15/31
3 miles northeast of Cannon Beach, Clatsop County. T. 5 N. R. 10 W.	R. laxiflorum	?	None	Occasional in occurrence.	Hansbrough, Childs	8/20/31
7 miles south of Tillamook. Tillamook County. T. 2 S. R. 9 W.	R. laxiflorum	?	None	Occasional in occurrence.	Hansbrough, Childs	8/22/31
Metolius River, Jefferson County, Sec. 10. T. 11 S. R. 10 E.	R. petiolare	25	Good	Rare, only four infected leaves.	Hansbrough, Childs	8/29/31
Cedar Creek, Marion County, Sec. 6. T. 9 S. R. 5 E.	R. bracteosum	?	?	Rare in occurrence.	Hansbrough, Childs	9/14/31

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MAP OF A PORTION OF MT. HEBO SHOWING LOCATION
OF PINUS STROBUS PLANTING
AND ADJACENT STREAMS

T. 4 S., R. 9 W., Willamette Meridian



Heavy alder and brush

Heavy brush and R. bracteosum

R. bracteosum exposed and infected with Cronartium ribicola

*Reported planted but none found.

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L. N. Goodding

PREERADICATION SURVEY OF BREITENBUSH PLANTING (T. 9 S., R. 8 E., and T. 10 S., R. 8 E.)

A preeradication survey was made of the Breitenbush area in September, 1931. The purpose was primarily to determine the species and amount of Ribes associated with the pines and the nature of the area with a view to making recommendations to the Forest Service regarding the control of blister rust. The Forest Service supplied maps of the region, together with data on the time of planting and the species used.

The Forest Service has recently constructed an excellent road to Breitenbush Hot Springs. From this point it is 7-1/2 miles by a good trail to the planting. The part of the planting containing western white pine, about 800 acres in extent, occupies a portion of sections 31 and 32, T. 9 S., R. 8 E., and sections 4, 5, 6, 8 and 9, T. 10 S., R. 8 E. The accompanying map, traced from a rough topographic map prepared by the Forest Service, shows the location of the areas.

The land surrounding the planting now has a good stand of reproduction, about 90% of which is Douglas fir with some western white pine, hemlock and white fir. The burn on which the planting was made has an abundance of fallen timber of large dimension, but no seed trees. The brush cover consists mostly of Ceanothus velutina and Castanopsis chrysophylla, with dense willow and alder in many places along the streams.

White pine and Douglas fir among the planted trees are making the most satisfactory growth. Some of the higher land is too rocky to support forest growth of any kind. Ribes are comparatively scarce.

The entire planted area is unsurveyed. The nearest section corner on surveyed land was in a heavy blow-down and could not be located. This made it difficult to tie in the preeradication work. A compass and pacing traverse was run along the trail which extends length-wise through the planting and tied in with natural landmarks. The preeradication survey is based on this traverse. An attempt has been made to correlate these data with a rough topographic sheet supplied by the Forest Service since the time of the survey.

The sampling was done by a plot method. The man taking the data moved out at right angles to the trail through the planting. On a plot one chain square, all trees were counted; from this, a strip four chains long and one-fourth chain wide was run, on which all Ribes were recorded. The man then moved forward five chains without taking data, after which the process was repeated. These strips were run every half mile through the entire planting.

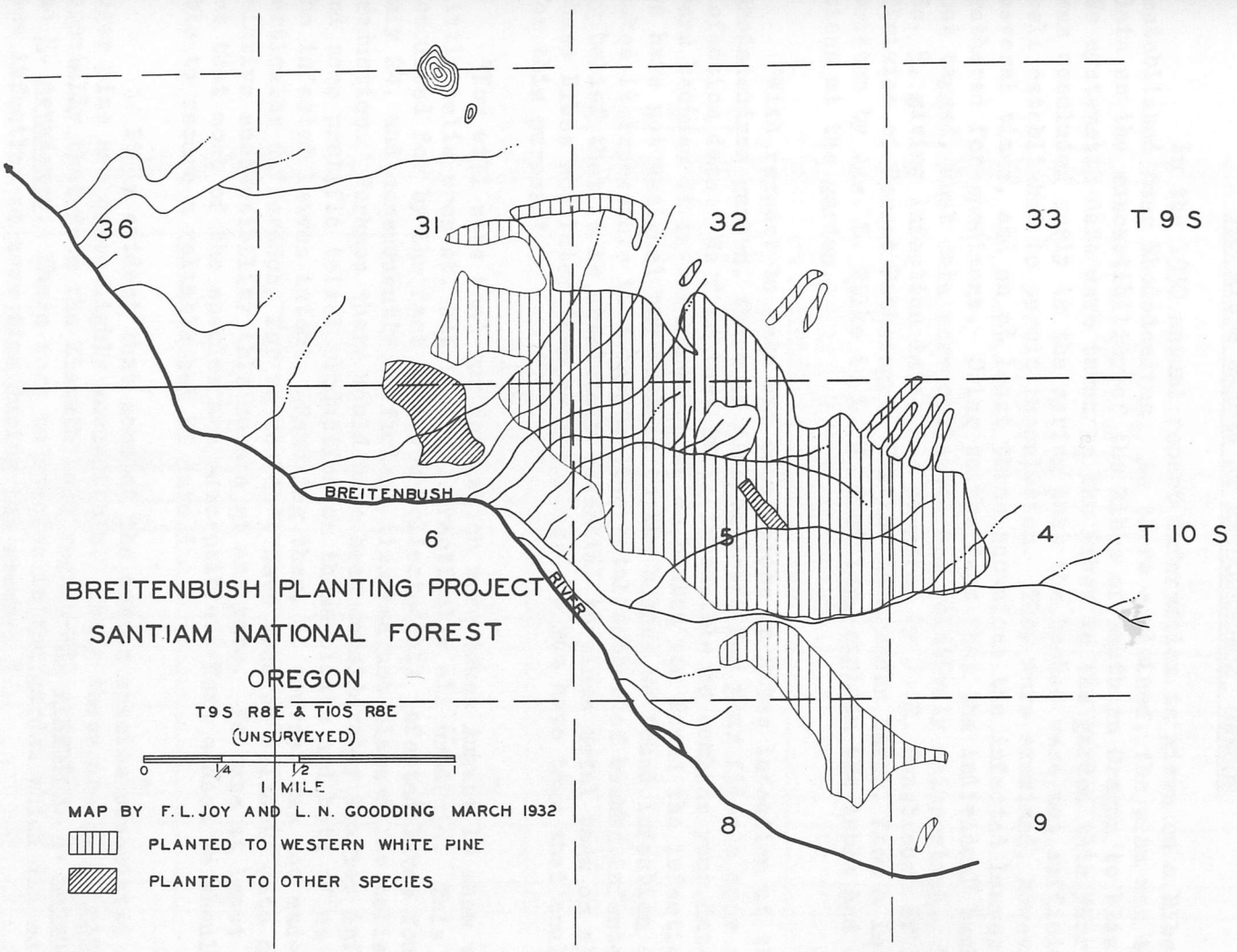
In stream type sampling the method was modified slightly. When a stream was crossed, a strip one-fourth chain wide was run up one side for four or five chains and down the other side in the same way, and Ribes bushes and live stem recorded. A general survey of the region revealed that most of the R. bracteosum and R. lacustre is along the main stream and along the tributaries near the main stream. The R. bracteosum is patchy. Both species are less abundant farther up the small streams. R. sanguineum is entirely upland.

The following table summarizes the data taken:

TABLE NO. 8

Data On	Average Number Per Acre	Number Feet Live Stem Per Acre
White pines	60	
Other species	18	
Stream type Ribes		
R. bracteosum		31,200
R. lacustre		5,850
Total		37,050
Upland Ribes		
R. sanguineum	4	212
R. lacustre	5	127
R. bracteosum	1	61
Total	10	400

The entire planting seems to offer no great difficulties. No concentrations of Ribes warrant chemical eradication. As the planting plots are widely scattered, much more land will need to be cleared of Ribes than is contained in the planting. Not less than 2,000 acres would be adequate.



Annual Report 1931
L. N. Goodding

COPIED BY R BLOMSTROM

THE RIBES GARDEN AT RHODODENDRON, OREGON

In the 1930 annual report information is given on a Ribes garden established near Rhododendron. As there explained, the plan was to obtain data on the susceptibility of the Ribes of southern Oregon to blister rust. No systematic data were taken on the Ribes in the garden this year, as it was concluded early in the spring that the bushes were not sufficiently well established to permit inoculation. They were examined, however, several times, and on at least three occasions the infected leaves were gathered for specimens. Owing to the fact that the individual bushes are not tagged, what data were collected are relatively unimportant. Table No. 9, giving infection data, was prepared by J. R. Hansbrough of the Division of Forest Pathology. The two paragraphs below, from a letter written by Jas. L. Midke to L. N. Goodding, explain the table and conditions at the garden.

"With respect to data and conclusions on Ribes infection at the Rhododendron garden, there is also enclosed for your files a copy of our infection data. We find that it is impossible to combine your data with ours because it is not known on which bushes you found the infection; also, we have not assigned any numbers to the bushes we found infection on. This makes it impossible to determine the total number of bushes infected. It is my belief that it is absolutely essential to place metal tags on all these Ribes not later than next spring. Do you have tags that could be used for this purpose?

"You will note that our data which were taken August 10 show very little telia present, but instead, practically all uredinia. This is accounted for by the fact that you collected all infected leaves found on July 24, and consequently sufficient time had not elapsed for telial production. Perhaps there would have been considerably heavier infection and more prolific telial production on these plants had both of us left the infected leaves intact. Removing them, of course, has not made any particular difference, for we couldn't have secured reliable data on relative susceptibility this season at any rate. We have at least found out that most of the species are susceptible. Next season we should be able to secure a reliable set of data."

It is evident that some of the common species associated with sugar pine are quite highly susceptible. Among these are R. klamathense--especially that from the Klamath Lake region--R. cruentum, R. marshallii, and R. nevadense. There were no species in the garden which did not show some infection at some time during the summer.

TABLE NO. 9

RIBES INFECTION DATA GARDEN OF SOUTHERN OREGON RIBES NEAR RHODODENDRON, OREGON*

Ribes Species	Number of Bushes Examined	Number of Bushes Infected	Av. Size of Bush Not Infected	Number of Leaves on the Infected Bush			Per Cent of Leaves Infected on the Average Bush	Per Cent Infected Surface Per Leaf	Per Cent I.S.B. 3**	Per Cent I.S.B. 2**	Per Cent I.S.D.N. 3**	Remarks
				Min.	Max.	Av.						
R. klamathense	12	4	40	25	80	55	7.73	5	5	95	-	Klamath Lake
R. kalmathense	9	-	50	-	-	-	-	-	-	-	-	Prospect
R. marshallii	54	7	50	36	70	56	12.00	12	2	98	-	Infection on one leaf of R. petiolare
R. nevadense	27	3	20	14	35	28	27.38	2	5	95	-	
R. hallii	49	1	25	-	-	18	1 leaf - 5.55	2	40	60	-	
R. binominatum	61	2	35	30	50	40	10.00	6	15	75	10	Infection on one leaf of R. petiolare
R. erythrocarpum	47	-	20	-	-	-	-	-	-	-	-	
R. velutinum	33	1	75	-	-	150	1 leaf - 6.67	30	-	100	-	
R. cruentum	40	6	75	30	175	80	8.13	10	20	78	2	

*Notes by J. R. Hansbrough, August 10, 1931.

**Per Cent I.S.B. 3 = Per cent infected surface bearing telia

Per Cent I.S.B. 2 = Per cent infected surface bearing uredinia.

Per cent I.S.D.N. 3 = Per cent infected surface dead, no telia.

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EDUCATIONAL WORK IN OREGON, 1931

Educational work was limited. Owing to lack of funds Oregon State College had no exhibits at the Oregon State Fair, and as the work has always been carried on in cooperation with it, nothing was done. During February, however, the college had its annual educational exhibition in which the Division was excellently represented. Goodding conducted the usual class work in botany, consisting of talks on blister rust, the use of slides showing the nature of the disease, and the supplying of blister rust material for laboratory use.

By request of C. J. Buck, Regional Forester, District 6, talks on blister rust were made at several of the Forest Training Camps. The first of these was held at Union Creek in the Crater National Forest, June 4, where sixty men were in attendance. The second was held on Smith's Fork in California, June 18, the men being from the Siskiyou National Forest. A similar number was in attendance. The third was held at Tiller on June 25, and consisted of men from the Umpqua National Forest. Owing to the dryness of the season, some of the training camps were not held.

On August 13 a talk on blister rust was made to students from the Ames School of Forestry at Paulina Lake.

Whenever talks were made, Questions and Answers and U. S. D. A. Miscellaneous Publication No. 23 were distributed.

A circular letter was sent to Federal and State Forest Service men, County Agents and fruit inspectors.

Form Letter

The annual letter to Forest Service men, fire wardens, field inspectors and county agents and fruit inspectors is presented in transcript.

"Dear Sir:

"Have you observed any white pine blister rust in your district this season? If you have, please tell us about it.

"Scouting for the disease this year is not complete, but the indications are that the spread to currants has been very great. Infection on stink currant can be found practically any place where the currants grow in the Coast Range west and north of Corvallis, and infection has been found for the first time in the McKenzie River drainage of the Cascades (at one place on Lost Creek, two on Horse Creek and one on the south fork

of the river). Infection was found on the planted pines on Mt. Hebo near Tillamook. These and the heavy infection on western white pine on Minto Creek, near Marion Lake, constitute the farthest known southward progression of the disease on pines in Oregon. If you can add to our information we shall appreciate it.

"If you do not have literature on blister rust we shall be glad to send you some."

RECOMMENDATIONS

Operations in Oregon will apparently be curtailed. This being the case, much desirable work will need to be postponed. Any additional reconnaissance done should be in the nature of preeradication surveys. Much work of this character could well be carried on in the Rogue River region about Prospect, Oregon, in the Bunker Hill Mine area, and in Swede Basin.

To keep the Wind River Nursery in a sanitary condition, two men should scout the stream type thoroughly. This should not require more than a month.

Two regions should be given careful attention in the program of scouting for blister rust. An attempt should be made to scout southward from the Minto Creek infection for long distances to determine possible "pockets" of the rust occasioned by and comparable to that at Minto Creek. The sugar pine regions in southwestern Oregon deserve better organized scouting effort than has been given them in the past.

Still Creek should receive the final clean-up.

The entire region about Breitenbush should be carefully examined before any Ribes eradication is attempted. While the survey seemed favorable to control at a low cost, there may still be unforeseen obstacles.

More educational work in the form of newspaper publicity and exhibits at fairs is desirable.

RIBES ERADICATION ON THE STILL CREEK AREA, SWIM, OREGON

By
B. A. Anderson*
Junior Forester

INTRODUCTION

There is probably not over one per cent of the white pines on the Still Creek plantation infected with blister rust at the present time. An inspection of the few cankers found tends to set 1927 as the year of the original infection. However, with Ribes species as plentiful as they were and with moisture conditions favorable to the development of the rust, there is little doubt that fatal damage would have resulted to the plantations if no further efforts had been made to protect them against blister rust. Practically no damage has been done up to the present time. Work to protect the white pines by the eradication of wild Ribes within and near the plantings was started during 1927. A small crew continued the eradication work during the 1928, 1929 and 1930 field seasons.

In the spring of 1931 a survey of conditions on the area was made and it was recommended that initial Ribes eradication work be completed during the current season. It was also recommended that the acreage eradicated of Ribes during previous years be checked over and cleaned of Ribes sprouts, missed Ribes, etc. The recommendations were accepted and a crew commenced work at Still Creek during the early part of July.

PURPOSES OF WORK

The purposes of the 1931 control measures as applied at Still Creek were:

1. To complete the initial eradication of Ribes within and near the boundaries of the white pine plantations.

2. To substantiate former Ribes eradication efforts.

LOCATION AND DESCRIPTION OF AREA

The Still Creek plantings cover approximately 900 acres in the Still Creek drainage and are located on an area burned over in 1910 in the Mt. Hood National Forest, township 3 south, range 8 east, Willamette Meridian. Almost all of the acreage represented in the plantation was planted to pine during 1915, 1918 and 1919. At some points the plantings border on Still Creek, and at others they are several hundred feet higher

*Field supervision by T. B. Onstat.

on the slopes.

The heavier concentrations of Ribes were found in or near the stream type, with Ribes lacustre and R. bracteosum predominating. A few bushes of R. triste also occurred in the stream type. R. lacustre, R. sanguineum and R. viscosissimum occurred on the hillsides.

The stands of planted pine are in a thrifty condition and are supplemented by a fine stand of natural white pine reproduction. If this region can be protected from fire, insects and blister rust, there should result excellent stands of white pine.

METHODS AND EQUIPMENT

Camp was established about three miles from Summit Meadows at the old planters' cabin on Still Creek, which was centrally located with respect to the area to be worked. Three pack horses were used about one day a week to bring in supplies. Chemical was brought in and distributed on the job in the same manner. On an average, 13 men were employed for a period of three months, though at the peak of the season a 20-man unit was maintained for a month. Eradication methods consisted of hand pulling and knapsack spraying.

1. Hand pulling methods.

Hand pulling supplemented with the use of Ribes tools (the long handled hodag proved the most efficacious) was resorted to for the eradication of R. sanguineum, R. triste and R. lacustre. Scattered bushes and a few patches of R. bracteosum were also hand pulled.

2. Knapsack spraying methods.

The concentrations of R. bracteosum were sprayed with a 15 per cent solution of Atlacide after the associated Ribes were pulled out. Only in one instance did this procedure vary, that being on Creek No. 5. Here it was out of the question to first pull the R. lacustre and then spray the R. bracteosum. This was due to the length of time remaining available and also because the two species were so large and intermingled, and formed acres of dense concentrations. In this case R. lacustre was also sprayed.

In addition to spraying the aerial parts of the Ribes, a ground drench was applied. This consisted of kicking and roughing up the ground at the base of the Ribes bushes and they spraying the ground thoroughly for several feet about the plant. By this procedure it was hoped that

through the absorptive power of the roots in taking up a solution, the Ribes bushes might absorb sufficient chemical to obtain a better kill. In this work No. 111 medium discs were used for applying the spray.

Various sizes of spraying crews were tried out. With the average conditions on the area, a 5-man crew consisting of four men spraying a a foreman to mix the chemical and lay out string lanes worked most efficiently. In the heavier concentrations, larger crews were successfully used as a foreman could supervise the efforts of six men as easily as four, thereby tending toward increased efficiency.

Due to the rough topography and the need for chemical in different parts of the area, trails had to be constructed. The longest of these extended up Creek No. 5 and was 1.5 miles in length. Two other short trails were made for distributing chemical along Still Creek.

WORK PERFORMED AND RESULTS

TABLE NO. 1

SUMMARY OF RIBES ERADICATION BY HAND PULLING METHODS

* Ribes Class	Man Days	Acres	Ribes Pulled					Ribes Per Acre	Man Days Per Acre
			R lac.	R. brac.	R. sang.	R. triste	Ribes Total		
Stream Type									
0-25	14.00	37.50	508	73	1	1	583	16	.37
26-50	18.00	33.00	1,092	136	4	22	1,254	38	.55
51-100	67.25	104.00	7,893	343	9	-	8,245	79	.65
101-200	119.75	133.00	17,956	1,071	10	457	19,494	147	.90
201-400	142.50	93.20	25,802	1,779	8	309	27,898	299	1.53
401-800	161.25	66.75	31,920	1,778	38	980	34,716	520	2.42
801-1600	120.00	25.15	26,115	1,187	6	-	27,308	1,086	4.77
1601-3200	37.50	4.00	8,467	79	1	-	8,547	2,137	9.38
3200-Over	31.00	2.40	9,410	36	-	-	9,446	3,936	12.92
Totals or Averages	711.25	499.00	129,163	6,482	77	1,769	137,491	276	1.43
Open Reproduction Type									
0-25	.75	3.00	54	-	2	-	56	19	.25
51-100	11.25	20.50	1,629	4	3	3	1,639	80	.55
101-200	9.00	11.80	1,683	10	-	3	1,696	144	.76
201-400	1.50	1.00	324	-	-	-	324	324	1.50
Totals or Averages	22.50	36.30	3,690	14	5	6	3,715	102	.62

*Ribes per acre.

TABLE NO. 2

SUMMARY OF RIBES ERADICATION PERFORMED BY HAND PULLING METHODS IN OPEN REPRODUCTION AND STREAM TYPE BY CLASSES

Ribes Class	Man Days	Acres	Ribes Pulled					Ribes Per Acre	Man Days Per Acre
			R. lac.	R. brac.	R. sang.	R. triste	Total		
0-25	14.75	40.50	562	73	3	1	639	16	.36
26-50	18.00	33.00	1,092	136	4	22	1,254	38	.55
51-100	78.50	124.50	9,522	347	12	3	9,884	79	.63
101-200	128.75	144.80	19,639	1,081	10	460	21,190	145	.88
201-400	144.00	94.20	26,126	1,779	8	309	28,222	300	1.53
401-800	161.25	66.75	31,920	1,778	38	980	34,716	520	2.42
801-1600	120.00	25.15	26,115	1,187	6	-	27,308	1,086	4.77
1601-3200	37.50	4.00	8,467	79	1	-	8,547	2,137	9.38
3201-Over	31.00	2.40	9,410	36	-	-	9,446	3,936	12.92
Totals or Averages	733.75	535.30	132,853	6,496	82	1,775	141,206	263	1.37

TABLE NO. 3

ANALYSIS OF RIBES ERADICATION BY SPRAYING METHODS

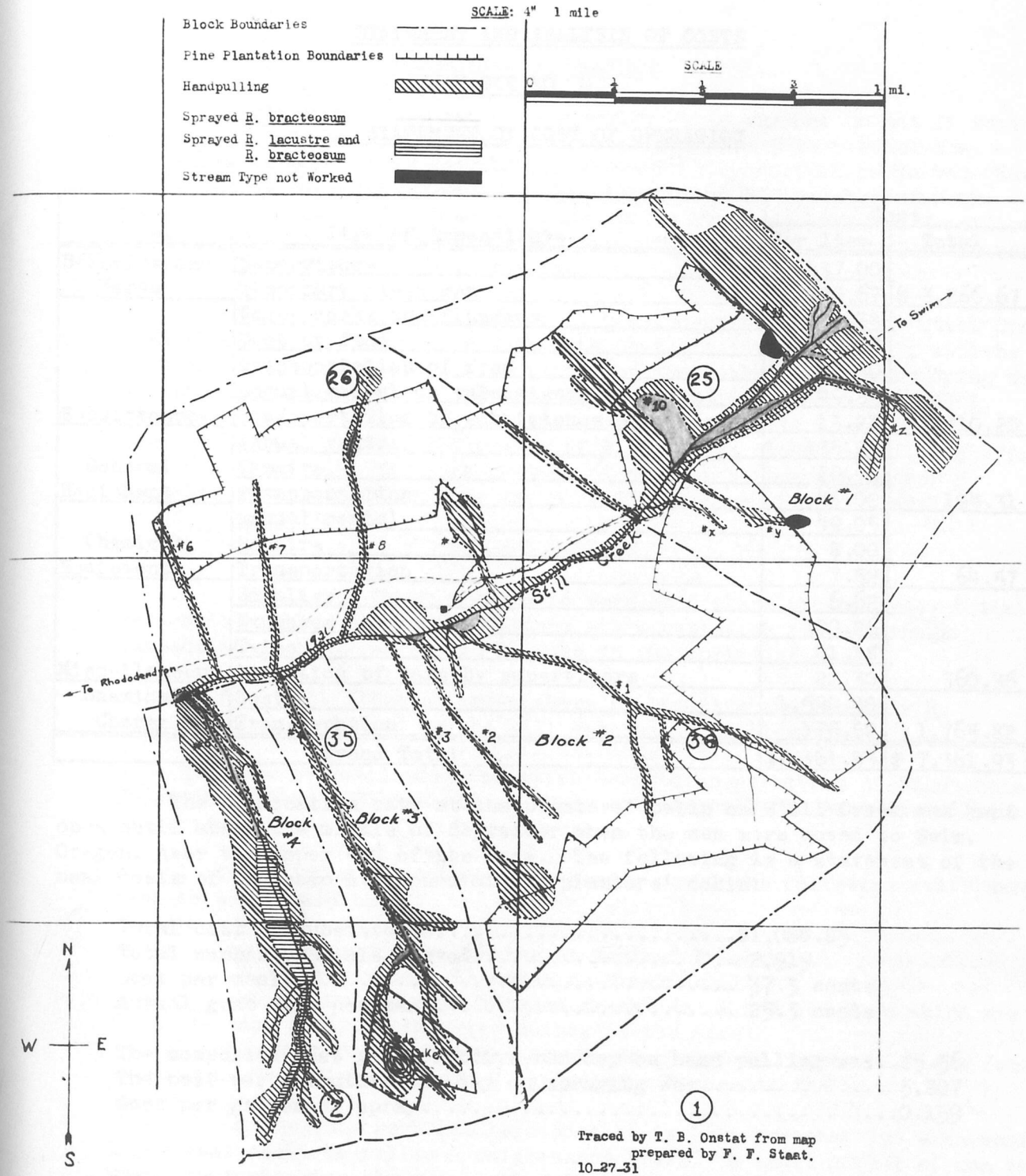
Gallons Per Acre	Man Days	Acres	Total Gallons	Man Days Per Acre	Gals. Per Man Day	Gallons Per Acre
11-20	7.00	7.2	134	.97	19.1	18.6
21-40	9.50	10.9	360	.87	37.9	33.0
41-80	60.50	33.2	2,088	1.82	34.5	62.9
81-160	137.75	51.5	5,788	2.67	42.0	112.4
161-320	46.25	15.0	2,716	3.08	58.7	181.1
Totals or Averages	261.00	117.8	11,086	2.22	42.5	94.0

Eight tons of Atlacide were used on the Still Creek area.

The map included in this report shows the pine plantation boundaries, the acreage on which Ribes were hand pulled and on which R. bracteosum and R. lacustre were sprayed with a 17 per cent solution of Atlacide, and stream type not yet worked.

RIBES ERADICATION ON STILL CREEK PLANTING AREA

T. 3 S., R. 8 E., WILLAMETTE MERIDIAN



Traced by T. B. Onstat from map prepared by F. F. Staat.
10-27-31

Annual Report, 1931
B. A. Anderson

STATEMENT AND ANALYSIS OF COSTS

TABLE NO. 4

STATEMENT OF COST OF OPERATION

Item of Expenditure		Cost	
		Per Item	Total
Salaries and Wages	Supervisors	$ 437.00	
	Temporary field men	2,829.67	$ 3,266.67
Subsistence	Wages cooks and flunkies	194.33	
	Cost of food	1,358.27	
	Transportation of food	94.50	
	Annual rental on subsistence equipment	49.89	
	Transportation of subsistence equipment	13.21	1,710.20
General Equipment	Annual rental	135.86	
	Repairs	10.43	
	Transportation	48.02	194.31
Chemical Equipment	Annual rental	49.05	
	Repairs	8.00	
	Transportation	7.52	64.57
Miscellaneous	Supplies	6.62	
	Expenses	300.26	
	Twine	31.18	
	Operation of cars by supervisors	22.30	360.36
Chemical Charge	Cost	1,590.30	
	Transportation	175.52	1,765.82
Grand Total		$7,361.93	$ 7,361.93

The eradication camp at the planters' cabin on Still Creek was kept open until about the middle of September when the men were moved to Swim, Oregon, near the upper end of the area. The following is a statement of the meal costs of the camp stationed at the planters' cabin:

Total cost of subsistence.....$1,088.85
Total number of meals served..... 2,919
Cost per meal..... 37.3 cents
Actual grub cost per meal..... 25.3 cents

The composite cost per effective man day on hand pulling was..$5.56
The cost per effective man day on spraying was.....5,807
Cost per gallon of spray..... ...0.159

DISCUSSION AND ANALYSIS

Although there was some question as to whether or not it would be necessary to eradicate the Ribes from Creek No. 5 to protect the plantings of pine about Veda Lake, it was finally decided to do so. Due to the heavy concentrations of R. bracteosum and R. lacustre on this drainage, the cost of cleaning up the entire planting area was considerably more than was originally estimated, since the original estimates did not include the working of this drainage.

An inspection of sprayed R. bracteosum bushes on the Still Creek area this fall does not give much hope that a satisfactory kill will be secured. Parts of the aerial portions of the bushes seem to be dying back and show the same black streaks in the cambium layer which sprayed R. petiolare exhibits when the chemical is taking effect. Beyond the total loss of leaves, the sprayed bushes of R. lacustre showed no killing effect from the chemical. The root systems of neither R. bracteosum nor R. lacustre seemed to be showing any marked influence of the Atlacide.

RECOMMENDATIONS

The Still Creek area is in very good shape at the present time and before the following recommendations are accepted, a very thorough inspection of the area should be made in the spring of 1932.

1. Hand pull Ribes on areas where R. lacustre and probably R. bracteosum were sprayed as the kill secured is problematical.

2. Check over all sites on which heavy concentrations of Ribes were found during the 1931 season, as there will probably be some missed bushes and sprouts appearing from broken crowns.

3. In addition to the above necessary work, the following small areas need to be cleaned up:

a. Approximately 3 acres at head of Y Creek.
b. Approximately 16 acres on Creek No. 11.
c. The upland type between creeks No. 1 and No. 3 on which are found as many as 30 R. lacustre bushes to the acre.
d. Upland type between creeks No. 4 and No. 5 on which are found as many as 40 R. lacustre and R. sanguineum bushes to the acre.

After this work has been done it is believed that the area would be on what could be called a maintenance basis. A small number of man days spent on rechecking the area each following year should be sufficient to keep the Still Creek plantation in a blister rust free condition.

BLISTER RUST CONTROL WORK IN CALIFORNIA
1931

Blister rust control activities in California were continued as a cooperative project between the Bureau of Plant Industry and the California Department of Agriculture, the California State Board of Forestry, College of Agriculture, University of California, and the Department of Botany, University of California. There is given below the amendment to the basic memorandum of understanding, which was drawn up to cover the cooperative work for the fiscal year 1932 beginning July 1, 1931:

MEMORANDUM OF UNDERSTANDING
Between
THE BUREAU OF PLANT INDUSTRY, U. S. DEPARTMENT OF AGRICULTURE
and
THE CALIFORNIA DEPARTMENT OF AGRICULTURE - - - THE CALIFORNIA STATE BOARD OF FORESTRY - - and the COLLEGE OF AGRICULTURE and DEPARTMENT OF BOTANY, UNIVERSITY OF CALIFORNIA
Relative to
Cooperative White Pine Blister Rust Control Work in California

Effective July 1, 1931

* * * *

A. The BUREAU OF PLANT INDUSTRY agrees to:

(1) Pay the salaries and necessary travel expenses of one or more employees who shall conduct such work;
(2) Assist in systematically locating and destroying cultivated black currants (Ribes nigrum) under state authority;
(3) Conduct experiments in control reconnaissance and local Ribes eradication, demonstrate the practical application of control practices, and obtain data on the spread of the rust; and
(4) Coordinate control activities of the several cooperating states and agencies by furnishing regional leadership and supervision, and to provide employees and the cooperating agencies with blister rust subject matter and technical information.

B. The CALIFORNIA DEPARTMENT OF AGRICULTURE agrees to:

(1) Pay the salaries and expenses and direct the work of one or more men who shall, during the proper season, inspect plant shipments for violations of blister rust quarantines;
(2) Use its regular employees, so far as their other duties permit, and direct their work in systematically locating and destroying cultivated black currants, scouting for white pine blister rust and inspecting nurseries for this disease;

(3) Undertake such destruction of white pine or Ribes in California and such enforcement of state laws as may be necessary for the effective prosecution of blister rust control work; and

(4) Furnish the state leader in charge of blister rust control work in California such office space as may be necessary for the proper conduct of his work.

C. The CALIFORNIA STATE BOARD OF FORESTRY agrees to:

(1) Use its regular employees, so far as their other duties permit, in systematically locating and eradicating cultivated black currants, scouting for white pine blister rust and assisting in the compilation of information concerning location, ownership and volume of sugar pine stands as a basis for control work.

D. The COLLEGE OF AGRICULTURE, UNIVERSITY OF CALIFORNIA, agrees to:

(1) Assist the employees of the Bureau of Plant Industry, through the University Division of Forestry, by furnishing available technical advice and records;

(2) Provide office and laboratory facilities, through the University Division of Forestry, for the employees of the Bureau of Plant Industry who are stationed in California to conduct technical studies upon the feasibility of chemical eradication of Ribes.

E. The DEPARTMENT OF BOTANY, UNIVERSITY OF CALIFORNIA, agrees to:

(1) Assist employees of the Bureau of Plant Industry engaged in technical investigation of the chemical eradication of Ribes, by furnishing technical advice, and laboratory space for three workers.

F. It is MUTUALLY AGREED that:

(1) This memorandum may be terminated at any time by any one of the parties by written notice, and may be amended by mutual written agreement;

(2) The cooperative plan of work in this memorandum will be followed as being the best method of control of white pine blister rust in California;

(3) All official records and reports of work performed under this agreement shall be open to inspection by any or all parties to this agreement, that all findings of blister rust made by any party to this agreement shall be promptly reported to all other parties to this agreement and that all specimens collected by any party to this agreement which are suspected of being infected with blister rust shall be submitted promptly to the Bureau of Plant Industry for final determination;

(4) The results of the cooperative work may be published jointly, or upon mutual agreement by either cooperating party, due credit being given to the cooperating agencies. All manuscripts therefor shall be criticised by

the cooperating parties before publication; and all form letters, bulletins and any other circulars to be mailed in penalty envelopes shall be submitted in manuscript form for approval by the Bureau of Plant Industry before being printed or distributed;

(5) Obligations by the Bureau of Plant Industry are contingent upon appropriations being made therefor by Congress; and no funds of the United States shall be expended in compensation for host plants destroyed in control work;

(6) For the fiscal year 1932, the Bureau of Plant Industry shall contribute in value approximately $34,000 to the support of this cooperative work; the California Department of Agriculture approximately $9,000, the California State Board of Forestry approximately $3,000, the College of Agriculture, University of California, approximately $10,000, and the Department of Botany, University of California, shall contribute in value approximately $3,000, thereafter the amount to be contributed by each shall be determined and agreed upon by supplemental correspondence or amendments.

Date	Signature
10/5/31	(s) Dudley Moulton Director, California Department of Agriculture
9/30/31	(s) L. B. Pratt State Forester, California State Board of Forestry
10/6/31	(s) C. B. Hutchison by Thos. Tavernetti Dean, College of Agriculture, University of California Asst. Dean
10/6/31	(s) W. A. Setchell Department of Botany, University of California
1/21/32	(s) Wm. A. Taylor Chief, Bureau of Plant Industry (J.F.M.)

BLISTER RUST ACTIVITIES IN CALIFORNIA, 1931

By
George A. Root
Associate Pathologist

INTRODUCTION

Reports on the California work have been prepared by the several project leaders in charge. The subjects reported on are as follows: Ribes Ecology, California, 1931 by F. A. Patty, Assistant Pathologist; Experimental Ribes Eradication, Lassen National Forest, California, 1931 by W. V. Benedict, Assistant Forester; and Control Reconnaissance on the Klamath National Forest, California, 1931 by T. H. Harris, Junior Forester. The results of the investigations of Ribicides in California are incorporated in G. R. Van Atta's special report.

BLACK CURRANT ERADICATION

This project, as far as an organized program is concerned, was brought to a close in 1930. The discovery and removal of bushes which may be found in the future are largely left to the various agricultural commissioners or their inspectors. Members of the blister rust personnel may find plantings in the course of their work and remove them as in the past.

NURSERY INSPECTION AND QUARANTINE MATTERS

The status of this work remains the same as last year. The Bureau of Nursery Service of the State Department of Agriculture conducts a certain amount of regulatory and inspection work and is cognizant of the part played by Ribes in control of blister rust. When this disease becomes established in the state, the inspection of blister rust hosts in nurseries will assume a much more important aspect than it does at the present time.

Contraband material in the way of blister rust hosts is continually being intercepted at the border stations by State officials. This is particularly true in the case of Ribes, when the red flowering currant (Ribes sanguineum) is in bloom in the early spring. The entrance of host material through these stations may present more of a menace than does the entrance of such material through transportation by common carriers.

SANITATION OF NURSERIES

The need for the sanitation of several nurseries which are growing 5-needled pines (See Report of 1930) is not particularly urgent at the present time. Until the rust makes its appearance in the state or is found more widespread near the California border, actual eradication of Ribes around these nurseries can be deferred without danger.

The nursery at the Feather River Experiment Station near Quincy in Plumas County was visited this fall. This is under the jurisdiction of the California Forest Experiment Station. This nursery for some years had practically been abandoned but of late has taken on new activity. Several species of forest trees are now being propagated in nursery beds. Three of these beds contain sugar pine and it is reported about one-third of the nursery will be devoted to this species sometime in the future. These are grown in various types of soil to ascertain which produces the best growth. Though the nursery is primarily for experimental purposes, these trees on reaching a certain age are given to public and private agencies throughout the state. Thus there is some distribution, and sanitation of this nursery would be in order when circumstances warrant. A casual inspection of the 1500 foot zone revealed no difficulty in securing a protective area.

SCOUTING FOR THE DISEASE

Northern California, particularly the northwest section, continues to be the most likely place for the rust to enter the state. This was brought out again this year, when the rust was found on Brush Creek in Curry County, Oregon, one of the two locations at which the rust was found in 1929. This would seem to indicate that infected pine is nearer this point than is known at the present time. Considerable scouting was done by the Oregon men but no other infections were found. This did not preclude the possibility that the rust would not be found in California, but the chances of its being found there were somewhat lessened.

It seemed most desirable to start scouting on the coast as soon as possible. On September 13, Patty and the writer left Redding, taking the lateral highway which runs through Weaverville to the coast. Inspection of Ribes was started 15 miles west of Redding and continued to Blue Lake not far from the coast. The greatest number of inspections were made on R. cruentum. One side trip of seven miles was made out of Helena, hoping to find R. bracteosum but without success. Much of the country traversed was quite dry with sugar pine scattered sparingly most of the way. A trip of 12 miles was made out of Willow Creek to the Hoopa Indian Reservation. R. cruentum was the predominating species found. R. bracteosum was first observed about 15 miles west of Willow Creek and at varying intervals to Blue Lake.

On reaching the coast, inspections were made at various points from the mouth of the Klamath River near Requa to Crescent City. Later on inspections were made south of Requa to Trinidad. From Crescent City scouting was done along the Smith River drainage to the Oregon line. Two side trips were made, one over the old Grants Pass Road to the north and one to Big Flat to the south. On both trips few Ribes were noted but there

was an excellent opportunity to observe reproduction of western white and sugar pine. Much of it was of the open type.

Inspections of R. bracteosum continued to the north of Crescent City and in the vicinity of the town of Smith River. From this place one side trip was made to Low Divide which afforded good pine but poor Ribes inspection.

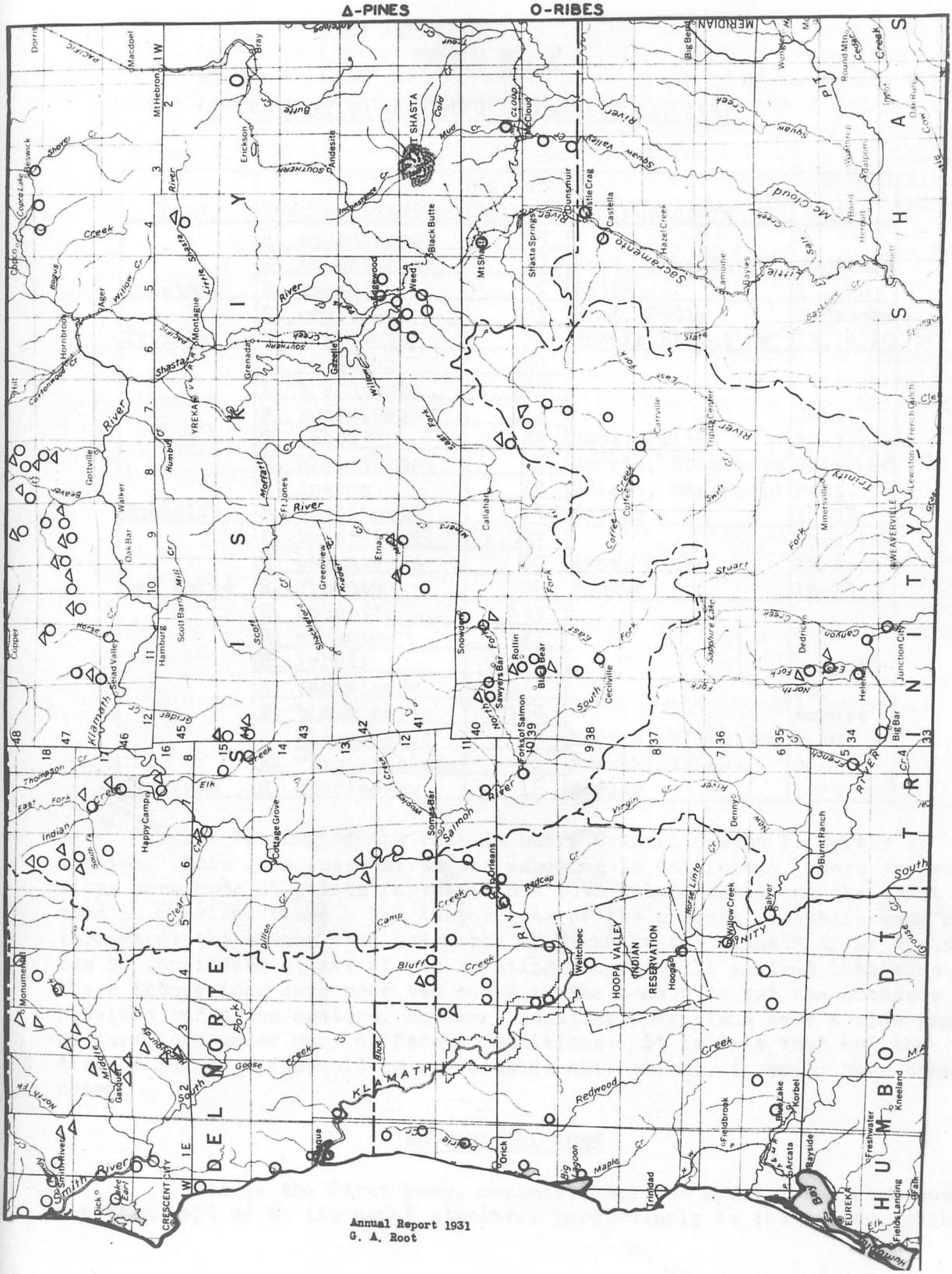
Harris and Blomstrom started work in the vicinity of Scott Valley, continuing south to a point near Trinity Centre, then west through Sawyer's Bar to the Klamath River Highway and then to Orick.

Benedict started scouting the territory in the vicinity of Mt. Shasta City, Weed and Castella. The Mt. Shasta country has always been considered a likely place for the rust to gain a foothold. It is cut by numerous streams and has a rainfall exceeded only by that of the coast region.

The following tabulation summarizes the scouting work performed during the 1931 field season:

SCOUTING INSPECTION POINTS
CALIFORNIA
1930-1931

Δ-PINES O-RIBES



Annual Report 1931
G. A. Root

TABLE NO. 1

SUMMARY OF SCOUTING IN CALIFORNIA, 1931

County	Species Examined	No. of Bushes	Inspectors	Date
Shasta	R. sanguineum	25	Root, Benedict, Patty	September 13, 20
	R. klamathense	10		
	R. cruentum	8		
Trinity	R. cruentum	163	Root, Patty	September 13,14,20
	R. nevadense	21	Harris, Blomstrom	
Humboldt	R. cruentum	334	Root, Patty Harris, Blomstrom McLees, Mansfield Sowder	June 18-24; July 3-10 Sept. 14-25
	R. bracteosum	282		
	R. sanguineum	112		
	R. lobbii	82		
	R. klamathense	42		
	R. inerme	12		
	R. laxiflorum	4		
Del Norte	R. bracteosum	1,092	Root, Patty Sowder	June 18-28; Sept. 16-23
	R. sanguineum	69		
	R. cruentum	22		
Siskiyou	R. lacustre	633	Harris, Blomstrom French, McLees Sowder	July 13-28; August 6-28; Sept. 1-24
	R. cruentum	387		
	R. lobbii	288		
	R. sanguineum	233		
	R. binominatum	104		
	R. klamathense	70		
	R. viscosissimum	70		
	R. bracteosum	16		

The finding of the rust in Curry County, Oregon is worthy of mention. This gave interest to the scouting in California, where inspections were made at points further south both inland and along the coast than in previous years. The inspections of the control reconnaissance crew throughout the summer west and north of Yreka in the Klamath River drainage can be considered a part of the scouting program. It is true that some of these inspections were made too early in the season to get the outposts of possible infection centers, however, scouting took place over a wide range of territory under many different conditions. It is felt that had the disease gained a foothold to any considerable extent, it would have been noted.

EDUCATIONAL WORK

This is the first year, perhaps, that the educational work has not been kept up to its usual standard, particularly in the way of exhibits.

Several things have contributed to this, the main reason being that the project leader was associated with the ecology studies during the period of most of the agricultural fairs. The progress of the work was not materially impaired nor the interest particularly lessened because of the absence of exhibits. However, this phase of the educational work should be resumed, most assuredly so when the rust makes its appearance in this state. It would be well to place exhibits at fairs in those counties near the northern border of California even prior to the time of its entrance.

The exhibit at the California Academy of Sciences in San Francisco was changed to meet the progress of the work in California.

In keeping with the policy of the U. S. Department of Agriculture in having its various divisions use the radio as a medium for educational purposes, a series of four talks on blister rust, including one on the California work, was broadcast over station KGO, in San Francisco. This is the key station of the National Broadcasting Company with which is associated a Pacific network of seven other stations situated in the western states.

An article giving the status of the blister rust at the end of 1930 was printed in one of the March issues of the Pacific Rural Press. The article, "Blister Rust Control in the Inland Empire" by S. N. Wyckoff was sent to all the County Agricultural Commissioners and to Supervisors of the national forests of the state. There was one newspaper release during the year.

An educational set of blister rust material and literature was given the San Francisco Teachers' College. This about completes the list of schools and colleges which were designated to receive such sets.

Specimen boxes and information were sent on request to a number of schools and individuals throughout the state.

A form letter regarding the present status of the rust was sent to County Agricultural Commissioners, Farm Advisors, Supervisors of the national forests, officials of the State Board of Forestry and others who are interested in the blister rust work. The letter is as follows:

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY
Cooperating With
State Department of Agriculture
State Board of Forestry
and
University of California

Blister Rust Control
Capitol Extension Bldg.
Sacramento, Calif.

The White Pine Blister Rust at the End of 1931

Except for several new pine infection centers in the white pine belt of northern Idaho, the status of the rust remains about the same as last year in the other western states. The currant-host infection in southwestern Oregon, found in 1929, continues to be the southernmost point of blister rust spread. This is within fifty miles of the California border, and from this point a southward spread has been anticipated.

Extensive scouting in Del Norte and Siskiyou counties of California has failed to reveal any signs of the disease. This has been in keeping with the results found in other areas near the outposts of rust infections. Next year the tables may be turned and an extensive spread take place. If so, we may expect to find it in this state.

The blister rust program was carried on this year as in the past. Control work was done on the Lassen National Forest, the third on which protective measures have been taken -- the other two being the Stanislaus and Plumas forests.

Very respectfully yours,

(s) George A. Root
State Leader in Blister Rust Control

Sacramento, Calif.
November 16, 1931

RIBES ECOLOGY, CALIFORNIA 1931

By
Frank A. Patty
Assistant Pathologist

PURPOSE

This report deals with the work in progress in making a comprehensive study of the Ribes of the sugar pine region of California to determir the factors governing dissemination and germination of the seed, and growth and distribution of the bushes. An understanding of the factors will assist in planning Ribes suppression programs and in developing management plans for sugar pine areas to be protected from blister rust.

OBJECTIVES

Various types of studies or experiments have been evolved in an attempt to answer the following list of questions:

1. What is the yearly rate of restocking of a sugar pine stand by Ribes after the timber is removed?

2. What is the yearly rate of restocking of a sugar pine stand by Ribes after the Ribes bushes have been removed?

3. Do new or old Ribes bushes supply the seed for the restocking of a sugar pine stand by Ribes after removing the timber?

4. How long will Ribes seeds remain viable if stored in the duff and soil?

5. What is the effect of duff and soil disturbances on the germination of Ribes seed?

6. How far from a given center are Ribes seed disseminated? What are the agencies of dissemination?

7. If a Ribes bush is allowed to produce one crop of seeds and then is destroyed, how many years will elapse before all of the seeds will have germinated?

8. Are Ribes seeds stored in the duff and soil? If so, in what layers and for how long a period?

9. What is the rate of growth of Ribes bushes?

10. At what age do new Ribes bushes and sprouts from old bushes begin to fruit?

LOCATION OF WORK

The studies have been limited to the Stanislaus, Sierra and Lassen National forests. However, most of the work has been centered around the Strawberry area of the Stanislaus National Forest as this forest is centrally located. These locations were selected because they offered a variety of growth conditions for cut-over and mature timber lands.

STUDIES BEGUN IN 1931

During the 1931 field season Ribes ecological investigations were continued. On account of a reduction in field force from five to two men, it was necessary to confine most of the work to checking plots already established. However, a few new studies were started. Although it is too early to expect any significant data from the new 1931 studies, a brief description of each one will be of interest.

A. *1-31 The dissemination of Ribes seeds.

Purpose. This study is designed to determine the distance Ribes seeds are disseminated and the disseminating agencies. These points are important to know in that areas freed of Ribes will probably be invaded to some extent.

Plot description and treatment. A circular plot, thirty feet in diameter and containing a group of approximately 100 Ribes roezli bushes, was laid out near Round Valley on the Lassen National Forest. Strips four feet wide and one hundred twenty feet long, originating at the center of the circle and running in the four cardinal directions, divided the circle into four quadrants. Bushes found on the strips within the circle were removed, as were the ones within a radius of half a mile outside of it. Thus Ribes were left only on the quadrants within the circle.

The plot is in the mature timber near a meadow on fairly level ground. Sheep are driven over the plot every year, consequently the soil is pretty well disturbed every spring after germination has taken place.

1-31A. A similar plot on level ground was established at Strawberry on the Stanislaus National Forest deep within a cut-over area from which the Ribes had been eradicated. This plot has been given serial number 1-31A so it can be identified with the one at Round Valley on the Lassen National Forest. A check of these plots every year should give some indication as to the distance Ribes seed will be spread from a given center.

*1-31. The "1" represents the serial number of the plot and the "31" the year in which the plot was established. 1931 was the first year this system of numbering has been used.

B. 2-31. Ribes seed storage in the duff and soil.

Purpose. The purpose of this study is to determine the presence or absence of Ribes seeds in the various layers of the duff and soil.

Plot description and treatment. Samples of duff and soil were taken from all of the timber types in mature timber and cut-over lands on the Lassen and Stanislaus National Forests. In taking a sample, a plot one meter square was measured off and the duff and soil near the boundaries of the plot were carefully cut away with a knife. The duff and soil were divided into three layers: (1) the top or loose layer of needles and other debris, (2) the compacted humus layer, and (3) part of the humus layer and the upper two inches of mineral soil. The layers were removed separately with a trowel, screened and the screening placed in paper bags. Each sample was divided in half. One portion was used in this study and the other in a study which will be described later.

A unit consisting of 144 compartments approximately 10" x 10" was made of cedar. The samples of the various layers of duff and soil were placed in the flats or compartments and then covered with fly screen to keep out birds and rodents. If seeds are present in the samples, germination will probably occur in the spring. A known number of seeds were planted in six of the flats containing sifted samples of duff and soil to check the efficiency of the arrangement.

C. 3-31 Ribes seed storage in the duff and soil.

Purpose. The purpose of this study is to determine the presence of absence of Ribes seeds in the various layers of the duff and soil.

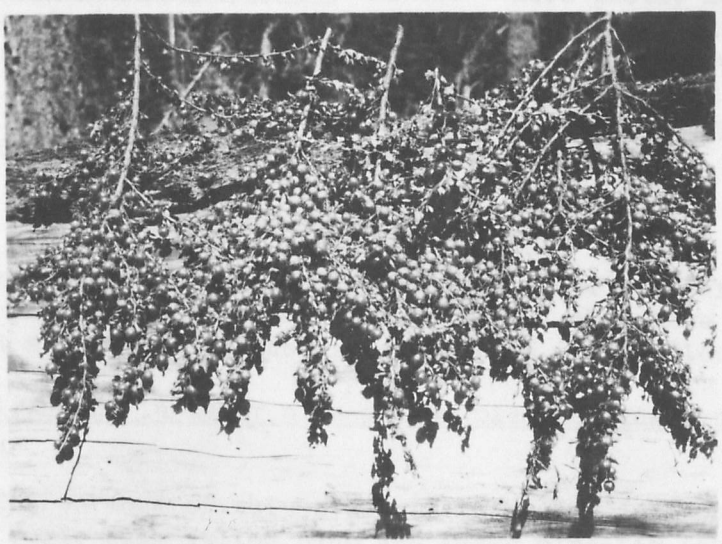
Plot description and treatment. Strips of ground six feet wide and forty chains long were cultivated to a depth of four inches near Strawberry on the Stanislaus National Forest and near Round valley on the Lassen National Forest where Ribes had been removed. The duff was raked off before the soil was cultivated. If there are any seeds stored in the soil some of them will probably germinate. The Strawberry area was freed of Ribes in 1926 and 1927 and a reeradication job was performed in 1930. The Round Valley area was freed of Ribes in 1931.

D. 4-31 Ribes seed germination study.

Purpose. This study was begun to determine how many years it will take for a given crop of seeds to germinate when planted in cultivated soil.



W. 969. Ribes seed germination plot showing dense growth of R. roezli near Round Valley Ranger Station. Lassen National Forest.



Six-year old R. roezli bush in fruit, growing in old sugar pine-fir cut-over, Stanislaus National Forest. Most of the fruits hang down under branches. For this reason stems were cut off and turned over to show fruits better.

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Plot description and treatment. Four plots 8' x 8' were established at Strawberry on the Stanislaus National Forest. The soil on the plots was cultivated, 2,500 seeds were planted in each one, and then the plots were made rodent proof. Check plots of the same dimensions were laid out near by but they were neither planted nor screened. All of the seeds used in this study were collected in the fall of 1931.

E. 5-31. The storage of Ribes seeds.

Purpose. This study is planned to determine how long Ribes seed will remain viable when stored under different conditions.

Plot description and treatment. In one case the seeds have been stored on top of the ground in a wooden container where they are subjected to extremes of moisture and temperature. In a second case the seeds were layered in sand in milk bottles. The latter were inverted and buried beneath 8 inches of soil and 4 inches of duff. It will be necessary to run germination tests on a part of each lot every year. There are approximately 25,000 seeds in each lot. The seeds are located in an opening on a north exposure near Strawberry.

F. 6-31. The effect of logging on Ribes reestablishment.

Purpose. This study was started to obtain a picture of conditions as they exist before and after an area is logged.

Plot description and treatment. On two 4-acre plots, located in virgin timber soon to be cut, permanent stations were established from which photographs were made of the density of the timber, ground cover and brush. A census of the Ribes population was also taken. One plot is located in sugar pine-fir and the other in sugar pine-yellow pine type and both are in the Stanislaus National Forest near Strawberry.

PROGRESS OF OLD STUDIES

The following studies which have been under way for a year or more will be taken up and discussed separately. None of them have been carried to completion but a few have yielded some valuable information.

A. Ribes reestablishment in sugar pine-yellow pine and sugar pine-fir types after logging.

Purpose. The purpose of this study is to obtain information on Ribes reestablishment in sugar pine-yellow pine and sugar pine-fir types following logging, and the influence of the removal of the Ribes bushes before and after logging on Ribes reestablishment.

Plot description and treatment. Two 5-acre plots in uncut sugar pine-fir type and two 5-acre plots in uncut sugar pine-yellow pine type were established in the spring of 1929 near Strawberry in the Stanislaus National Forest. Previous to logging, the Ribes bushes were removed from one sugar pine-fir and one sugar pine-yellow pine plot while on the two remaining plots a census of the Ribes plants was taken but they were not destroyed. The timber was cut immediately following establishment in 1929. Old and new bushes were removed in 1930 and 1931 on all plots constituting a check.

TABLE NO. 1

RIBES REESTABLISHMENT IN SUGAR PINE-YELLOW PINE AND SUGAR PINE-FIR TYPES AFTER LOGGING

Time Data Recorded	Sugar Pine-Fir Ribes Not Eradicated Before Logging — Plot No. 1				Sugar Pine-Fir Ribes Eradicated Before Logging — Plot No. 2				Sugar Pine-Yellow Pine Ribes Not Eradicated Before Logging — Plot No. 4				Sugar Pine-Yellow Pine Ribes Eradicated Before Logging — Plot No. 3			
	No. of Seedlings Per Acre	No. of Old Bushes Per Acre	Feet Live Stem Per Acre	No. of Fruits Per Acre	No. of Seedlings Per Acre	No. of Old Bushes Per Acre	Feet Live Stem Per Acre	No. of Fruits Per Acre	No. of Seedlings Per Acre	No. of Old Bushes Per Acre	Feet Live Stem Per Acre	No. of Fruits Per Acre	No. of Seedlings Per Acre	No. of Old Bushes Per Acre	Feet Live Stem Per Acre	No. of Fruits Per Acre
Before Logging	0	42	342	126	0	56	814	162	0	32	310	58	0	20	251	24
First Year After Logging	1	15	147	56	1	4	18	10	0	26	216	38	0	8	84	0
Second Year After Logging	202	8	*25	3	254	3	*[illegible]2	2	58	4	* 33	5	29	3	* 8	0

*Feet of live stem for seedlings not included.

Table No. 1 shows that Ribes seeds did not begin to germinate to any extent until the second year after logging. It is reasonable to assume that there were viable seeds stored in the soil because some of the old bushes that had escaped logging were bearing a few fruits in the fall of the same year in which the timber was cut. These old suppressed bushes frequently take on new life after the stand of timber has been opened up and produce fruits in abundance so an area will be immediately supplied with a few new seeds. The feet of live stem and the old bushes represent the Ribes present before logging. A few of these old bushes were missed during each check.

B. Ribes reestablishment in stream type after logging.

Purpose. This study was begun to obtain information on Ribes reestablishment in stream type after logging.

Plot description and treatment. One plot of six acres in uncut stream type was established in the spring of 1929 near Strawberry on the Stanislaus National Forest. Falling operation started almost immediately after establishment, consequently no Ribes data were taken previous to logging but it was estimated that the Ribes averaged 75 bushes per acre. The old and the new Ribes bushes were removed in 1930 and 1931, constituting a check of the plot.

TABLE NO. 2

RIBES REESTABLISHMENT IN STREAM TYPE

Ribes Species	Number of Ribes Per Acre							Feet of Live Stem Per Acre						
	Old Bushes Found in		Germinating in 1929 Found in		Germinating in 1930 Found in		Germinating in 1931 Found in	Old Bushes Found in		Germinating in 1929		Germinating in 1930		Germinating in 1931
	1930	1931	1930	1931	1930	1931	1931	1930	1931	1930	1931	1930	1931	1931
R.roez.	14	11	7	0	230	16	321	212	63	23	0	46.0	46	64
R.nev.	6	9	6	0	365	8	284	44	101	7	0	70.0	29	57
R.cer.	1	0	0	0	7	0	0	2	0	0	0	1.4	0	0
Totals	21	20	13	0	602	24	605	258	164	30	0	117.4	75	121

According to the results that are found in Table No. 2, a few seeds appeared the same year in which the timber was cut, but in 1930 and 1931 excellent germination occurred. Ninety-one more R. roezli seedlings per acre were found on the plot in 1931 than in 1930, while in 1931 there were 81 less R. nevadense seedlings per acre than in 1930. The total seedling production for 1930 just about equaled the total seedling production for 1931.

A comparison of Table No. 1 with Table No. 2 brings out the fact that in stream type many Ribes seedlings appeared the first year after logging, while in the sugar pine-fir and sugar pine-yellow pine types germination really began the second year after logging. These conditions may not prevail over all areas.

C. Ribes reestablishment after eradication on cut-over land.

Purpose. This study was begun to determine how many years elapse after Ribes bushes have been removed from an area before the year of maximum germination is reached. Over a period of four or five years there is usually one season in which the largest number of seeds germinate, and it is referred to as the year of maximum germination.

Plot description and treatment. One plot of 1.6 acres in sugar pine-fir type cut over in 1925 was established in the fall of 1930 at Cow Creek on the Stanislaus National Forest. The mature bushes on the area were bearing a heavy crop of fruits. All of the plants were grubbed out and the fruits were left on the ground in the approximate location of the old bushes. The old and the new bushes were removed in 1931 constituting a check of the plot.

TABLE NO. 3

RIBES REESTABLISHMENT AFTER ERADICATION ON OLD CUT-OVER LAND

Year Checked	No. of Bushes Per Acre	Live Stem Per Acre (Old Bushes)	No. of Fruits Per Acre	No. of Seeds Per Acre	No. of Seedlings Per Acre	Feet of Live Stem Per Acre (Seedlings)
1930 (Bushes removed)	1,476	35,700	37,815	1,512,600	-	-
1931	32	322	148	5,920	19,053	*1,905
Totals	1,508	36,022	37,963	1,518,520	19,053	1,905

*Estimated that seedlings average 1/10th foot of live stem per bush.

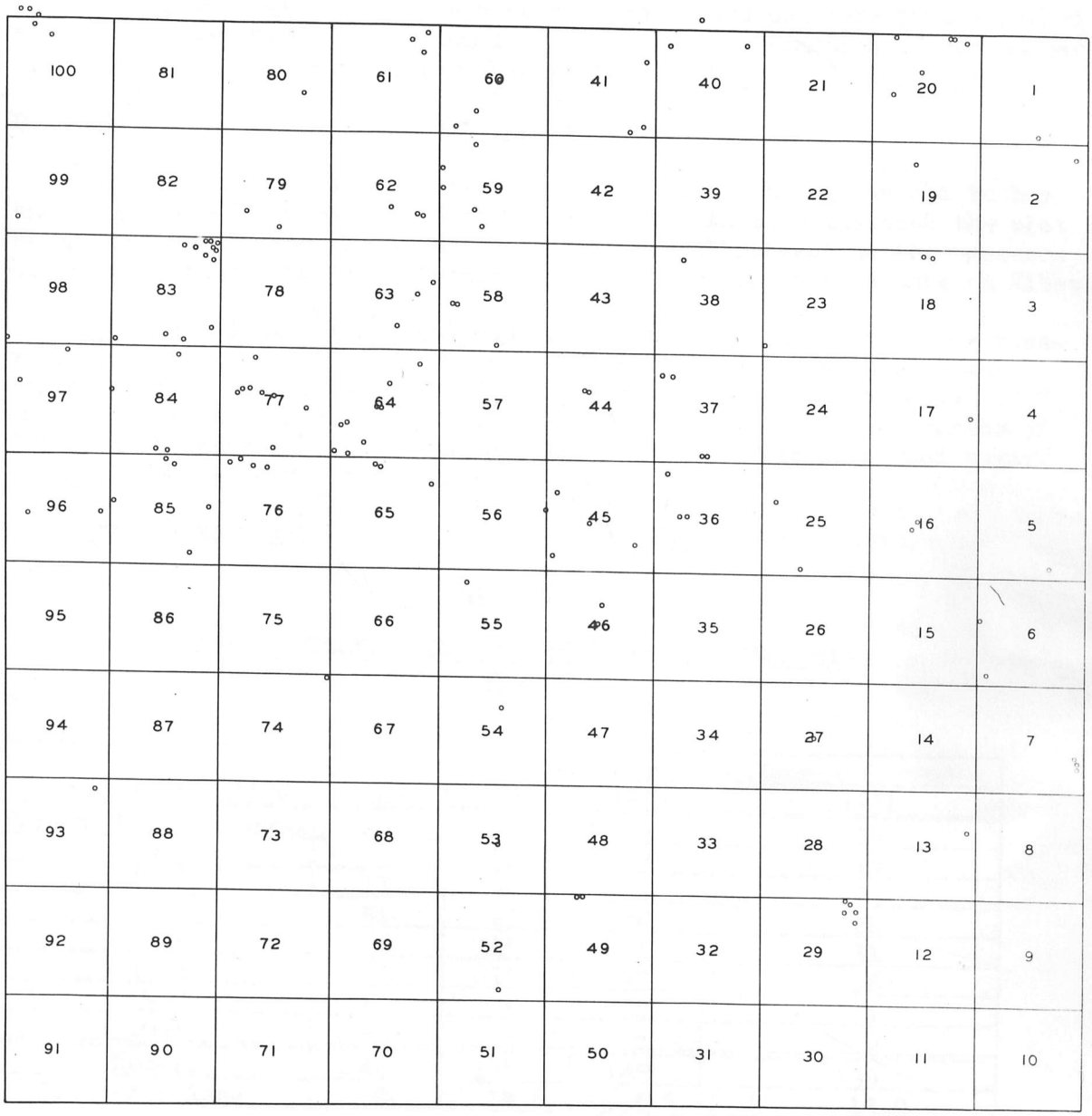
RIBES DISTRIBUTION MAP

OF

COW CREEK SAMPLE PLOT

STANISLAUS NATIONAL FOREST

CALIFORNIA



LEGEND

SCALE

1/4 1/2 CHAIN

○ RIBES BUSH

▨ SUB PLOT

RIBES DATA BY F.A. PATTY - MAP BY W.F. PAINTER

NOV. 13, 1931

ANNUAL REPORT 1931
F.A. PATTY

Table No. 3 gives a picture of the conditions as they were found on the plot in 1930. The large number of seedlings per acre that appeared the year after Ribes eradication is probably only a fraction of the number of potential seedling crops for this plot.

D. Ribes growth on the Cow Creek sample plot.

Purpose. In studies Nos. 1, 2 and 3 seedlings as well as old bushes have been removed every time a check was made. In this instance the plot is being studied to note the effect of Ribes reestablishment in the presence of fruiting bushes and to determine the influence of other plants on Ribes.

Plot description and treatment. One plot of ten acres in sugar pine-yellow pine type near Cow Creek on the Stanislaus National Forest was logged in 1923 and fenced in 1927. The Ribes bushes were staked in 1928 and the plot was checked in 1928, 1929, 1930 and 1931. Three-fourths of the plot is covered with a dense growth of brush. This is a good sugar pine site and a fair one for Ribes.

Results to date:

TABLE NO. 4

RIBES POPULATION OF COW CREEK SAMPLE PLOT 1928-1931

Year of Germination	Ribes Found Each Year			
	1928	1929	1930	1931
Present before logging	26	26	25	24
1925	3	22	14	14
1926	17	40	23	23
1927	31	28	28	28
1928	5	15	31	31
1929	-	15	32	18
1930	-	-	32	1
1931	-	-	-	0
Totals	82	146	185	139
Ribes Per Acre	8.2	14.6	18.5	13.9

There are a few interesting points which Table No. 4 brings out. An increase in the number of new Ribes bushes has occurred each year up until 1930 after which time (1931) no new bushes were found. A few Ribes seeds probably germinated in 1931; however, possibly none of them survived

due to the exceptionally dry summer. During this same year many of the more recently established bushes died and many of the old ones were probably injured by the drought and possibly they will be found dead when the next check is made. On account of the dense brush present on the plot a few Ribes bushes have been missed from year to year. This accounts for the discrepancies between vertical headings "1928" and "1929". Once the bushes are staked, there is a very slight chance of missing them in subsequent checks.

So far examinations of the dead Ribes bushes have given no indications that other species of brush are instrumental in shading out Ribes plants. In many instances they are successfully competing with dense growths of bear clover and Ceanothus.

E. Ribes germination and survival on dry slopes.

Purpose. Generally Ribes are not as numerous on dry slopes as they are on moist ones. Neither do they appear to restock an area, where dry conditions prevail, so readily after Ribes have been removed. If planted seeds are given moisture will they germinate and survive on dry slopes, or are the soil conditions unfavorable to Ribes growth? Further, are there seeds lying dormant in the soil that will germinate when moisture conditions become favorable?

Plot description and treatment. One set of 12 fenced milacre plots was established on a dry slope in 1929 and a second one of the same type in 1930 on the Strawberry area of the Stanislaus National Forest. Each set of plots was divided into thirds and treated as follows: (1) not disturbed, (2) duff and soil spaded under, and (3) duff removed and soil spaded. Half of the above-treated plots were irrigated and the other half were not. Sixteen whole fruits of R. roezli were planted, and staked on each milacre.

Results to date:

TABLE NO. 5

RIBES SEED GERMINATION STUDY ESTABLISHED 1929

Treatments Given Plots		Ribes Per Acre					
		Germinating Spring 1930	Surviving Fall 1930	Surviving Spring 1931	Surviving Fall 1931	1931 Seedlings Germinating Spring 1931	1931 Seedlings Surviving Fall 1931
Duff Removed Soil Spaded	Not irrigated	31,500	7,500	4,500	4,500	1,500	500
	Irrigated	15,500	10,000	6,000	6,000	26,000	23000
Duff and Soil Turned Under	Not irrigated	28,000	15,000	500	500	42,500	20,500
	Irrigated	34,000	23,000	12,500	8,500	21,000	8,500
Undisturbed	Not irrigated	12,500	4,000	500	-	3,000	2,100
	Irrigated	15,000	1,500	1,500	500	3,000	1,000

TABLE NO. 5A.

RIBES SEED GERMINATION STUDY ESTABLISHED 1930

Treatments Given Plots		Ribes Per Acre	
		Germinating Spring 1931	Surviving Fall 1931
Duff Removed	Not irrigated	None	None
Soil Spaded	Irrigated	9,500	9,500
Duff and Soil Turned Under	Not irrigated	None	None
	Irrigated	5,500	5,000
Undisturbed	Not irrigated	None	None
	Irrigated	2,000	1,000

Table No. 5 gives the results of two seasonal checks on the plot set up in 1929. More seeds germinated on the non-irrigated milacres than on the irrigated ones in 1930; however, more seedlings survived on the latter

than on the former in the fall of 1930 and the spring and fall of 1931. All of the planted seeds did not come through the first year and their germination and survival records for 1931 appear in the last two vertical columns of Table No. 5. In this case more seedlings germinated and survived on the irrigated milacres than on the nonirrigated ones in 1931.

In Table No. 5A will be found the results of the checks made on the plot established in 1930. Only a very small number of planted seeds germinated where moisture was available. Not a single seedling appeared on the dry milacres. No volunteer seedlings were found on either of the two sets of plots.

F. Soil and duff analysis for Ribes seeds.

Purpose. An attempt is being made in this study to determine if Ribes seeds are stored in different layers of the duff and soil.

Description of study. The methods used in collecting these samples as well as the places of collection were described in study 2-31. The samples which were collected in 1930 were run through a small fanning mill to separate the seed from the duff and soil. Seeds of plants that are associated with Ribes were collected to aid in identifying the Ribes seed. The 1931 collection of samples has not been put through the fanning mill.

Results obtained. The 1930 collection of duff samples was analyzed with the following results: 54 per cent of the samples of the top layer, 67 per cent of the middle layer, and 31 per cent of the third layer contained seeds of all descriptions. Ribes seeds were found in 12 per cent of the samples from the top layer, 12 per cent of the samples from the middle layer, and 5 per cent of the samples from the bottom layer. There was an average of four Ribes seeds per sample for all layers of duff and soil.

G. The effect of soil disturbances on Ribes seed germination.

Purpose. The study was begun to discover the effect of different types of soil disturbance on the germination of planted seeds and the ones already stored in the soil.

Description of plots and treatment. Seven fenced plots having either 24 or 36 milacres each were established in 1929 and 1930 in the Strawberry area of the Stanislaus National Forest. They were located in representative timber types and exposures from 4,500 to 6,500 feet in elevation. Each plot was divided into thirds and treated as follows: one third was fenced

with fly screen and covered with cheesecloth, another third was fenced with fly screen, and the last part was neither fenced with fly screen nor covered with cheesecloth. The fly screen was used to exclude rodents and the cheesecloth gave uniform shading. Milacres on the plots were given the following treatments: duff and soil undisturbed, needles raked off, duff partly raked off, duff completely removed, duff removed and soil spaded, and duff and soil cultivated together. All of the above disturbances were not made on each set of plots; however, a sufficient number was set up on representative sites. Half of each milacre was planted with from 8 to 16 medium sized Ribes fruits and the other half of each milacre was left unplanted.

Results to date:

TABLE NO. 6

INFLUENCE OF DUFF DISTURBANCE ON PLANTED RIBES SEED

Degree of Soil Disturbance	Number of Ribes Per Acre For 1929 Plantings							1930 Plantings		
	Germinating Spring 1930	Surviving Fall 1930	Surviving Spring 1931	Surviving Fall 1931	Germinating Spring 1931	Surviving Summer 1931	Surviving Fall 1931	Germinating Spring 1931	Surviving midsummer 1931	Surviving Fall 1931
Soil and duff undisturbed	143	36	36	36	1,392	685	428	529	265	59
Needles raked off	800	200	200	200	0	0	0	*	*	*
Duff partly removed	500	250	250	250	1,500	1,250	1,000	*	*	*
Duff completely removed	2,478	1,086	400	400	4,782	2,695	2,000	2,529	1,333	1,033
Duff removed, soil disturbed	10,821	6,750	5,322	5,214	22,500	12,500	9,536	3,866	1,600	833
Duff and soil disturbed together	11,812	5,750	4,562	4,000	23,750	9,125	6,062	1,909	909	591

*No data for 1930 plantings.

TABLE NO. 6A

INFLUENCE OF DUFF DISTURBANCES ON STORED RIBES SEED

Degree of Soil Disturbance	Number of Volunteer Ribes Per Acre for Plots Established in 1929						
	Germinating Spring 1930	Surviving Fall 1930	Surviving Spring 1931	Surviving Fall 1931	Germinating Spring 1931	Surviving Midsummer 1931	Surviving Fall 1931
Soil and duff undisturbed	0	0	0	0	250	36	36
Needles raked off	0	0	0	0	600	0	0
Duff partly removed	250	250	150	150	750	750	750
Duff completely removed	107	72	72	72	1,304	782	548
Duff removed soil spaded	1,739	1,000	913	913	4,785	3,107	3,000
Duff and soil disturbed together	250	250	125	125	438	0	0

Table No. 6 gives a summary of the number of planted seeds germinating and the seedlings surviving on the plots established in 1929 and 1930. If a Ribes fruit is planted in the fall, part of the seeds may germinate the following spring and part one year later. Vertical columns five and six represent this delayed germination and the number of seedlings surviving. Table No. 6A shows the number of stored seeds germinating and seedlings surviving on the plots established in 1929. No volunteer seedlings appeared on the plots established in 1930.

The results obtained from these plots, as well as general observations, indicate that duff and soil disturbances favor Ribes seed germination, while undisturbed duff does not favor germination. There are probably several reasons why duff inhibits Ribes seed germination and seedling survival; (1) the roots of the seedlings are unable to penetrate the lower packed layer of duff; (2) the duff dries out rather rapidly in the late spring, leaving the seedlings high and dry before the roots have had a chance to penetrate down to moisture; (3) if the seeds are in the soil beneath the duff, conditions for germination may not be favorable and in the event that

germination does take place, the seedlings are probably unable to push up through the lower packed layer of duff.

In checking these plots it was found that the Ribes seeds germinated early in the spring. Practically none germinated after May 15 in 1930 and 1931 although heavy rains fell in June.

DISCUSSIONS

At the present rate of logging most of the commercial sugar pine in California will probably be logged within the next fifty years, so it is necessary to know how soon Ribes will begin to restock a cut-over area and for how long a period restocking will continue. The information now available shows that after sugar pine-fir and sugar pine-yellow pine types are cut over, new Ribes begin to appear the second year, while in stream type they begin to appear the first year. No explanation can be given at this time why restocking begins the first year in the latter type and the second year in the former types.

Ribes will continue to restock a cut-over area for at least twelve years. On account of the wide variations in climatic conditions from year to year, difficulty is experienced in trying to determine how long the Ribes population will continue to increase, reach a maximum point and then begin to decrease on a cut-over area. This point can be illustrated by the Cow Creek plot of ten acres of timber land logged over in 1923. The Ribes population has been steadily increasing from 1925 to 1930. However, in 1931 not a single new bush was found and a number of the established bushes had died. The exceptionally long dry summer was reponsible for the failure of any new bushes to survive and for the death of some of the older bushes. If a favorable year for germination and survival of Ribes can be expected in 1932, an increase of the Ribes population on this plot will probably occur.

Logging operations do not destroy all of the old bushes on an area. Opening up the stand stimulates these old bushes to new growth and in a year or two they are producing an abundance of seed.

After Ribes seeds have begun to germinate on a fairly recent cut-over area, the seedlings continue to appear for at least two years. Just how long this condition will prevail has not been determined. The removal of all of the fruiting bushes on four 5-acre contiguous plots should help to answer these questions.

Evidence has shown that Ribes seeds are stored in the upper layer of loose needles and duff, in the middle compacted layer of duff and in the

soil immediately below the compacted duff layer. The presence of seeds in the compacted duff and the soil beneath it does not necessarily mean that they have been stored there for a long period. Conditions may be right during one season of the year for the seeds to work their way down through the duff to the soil.

Most of the Ribes seedlings that are found on cut-over timber land for the first two or three years come from the seeds that were in the duff or soil before logging. If this statement is correct, and the present data indicate that it is, the storage of seeds on moist slopes (north and east) is greater than it is on the dry slopes (south and west), since more seedlings are usually found on the former than on the latter after the timber is cut.

There are several reasons why this condition could exist: (1) The capacity of the soil for maintaining healthy, vigorous bushes on a moist slope is greater than that on a dry one, hence there would be more fruiting bushes per acre in the former case. (2) Where the duff has been disturbed the chances for seed germination in the spring may be nearly equal for both slopes but moist slopes favor seedling survival especially during dry years. (3) The soil and the duff dry out to a greater depth and are dry for a longer period of time on the dry slopes. Therefore the seeds that are stored in the soil are subjected to a longer period of desiccation and chances for killing are greater. (4) Twice during the last five years severe freezes have occurred and as a result the flowers and the tender shoots of Ribes bushes in exposed and dry places were killed. So marked was the effect of this killing at Hazel Green on the Stanislaus National Forest in 1929 that bushes bearing fruit were found only on moist protected slopes. The ones growing under the latter conditions were not far enough advanced to be affected by the adverse climatic factors. If this condition should prevail at intervals, seed production over a period of years on the moist slopes would exceed that on the dry ones. (5) The theory advanced by the Idaho ecology group that the duff acts as an insulator and prevents the stored Ribes seed from germinating and drying out may be considered in that the duff on the moist slopes in California is fairly comparable to that in the white pine belt of northern Idaho; while on the other hand the duff on the dry slopes in California is quite often very thin and therefore not as effective as an insulator. One or all of the preceding theories may explain why seed storage is greater on a moist slope than on a dry one.

The present data indicate that Ribes seed germination is influenced by the degree of duff disturbance. When the duff is lightly disturbed comparatively few Ribes seeds germinate. However, if the duff is completely removed and the soil is cultivated, or if the duff and soil are

cultivated together, excellent germination is obtained. A fair germination results when the duff is removed and the soil is not cultivated. These results have been obtained on adjacent plots in the presence of an abundance of light. (Ribes seed have germinated well in the absence of light in a previous study.) Planted or stored Ribes seeds respond about the same to duff soil and disturbances.

Additional facts pertaining to Ribes have been brought out in previous annual reports. These facts will be discussed so that a complete summary can be made in this report.

On an average, R. roezli bushes begin to bear fruit when they are four years old and continue to do so for fifteen years or more. In a few instances where bushes are growing under optimum conditions, a few large fruits are produced when the bushes are three years old. Under adverse conditions of growth fruiting is sometimes delayed two or three years after the normal period.

When Ribes bushes are broken off either by logging or improper grubbing, sprouting from the crown often occurs. The sprouts begin to fruit when they are two years old; for example, if the top of a bush is broken off in 1930 and sprouting results, fruits will be produced in 1932. After the Ribes on an area have been removed, it is important to prevent new and old bushes from reseeding the soil. In a cut-over area conditions remain right for Ribes seed germination for a long time.

The rate of Ribes reestablishment and the yearly increase of Ribes bushes have been determined for large cut-over areas on both the Stanislaus and the Sierra national forests. These points will be treated in detail in a separate paper. They are mentioned here because they have been discussed to some extent in previous reports.

Indications are that stored seed supply the new bushes that appear on a cut-over area for the first three or four years. In some of the dense stands of mature timber no old Ribes bushes are found but when the timber is cut many seedlings appear. Other mature stands have a few old fruiting bushes scattered about that could supply the seeds for the Ribes bushes that appear after logging. Some of the new bushes in both of the above cases probably come from seeds that have been stored in the duff or soil for a long or short period.

Light burning caused by forest fires assists Ribes seed germination by removing the duff mantle. Heavy burns, especially where logging debris is consumed, are not favorable to germination. In general, burning of any sort tends to increase the brush on an area, making the removal of Ribes very difficult.

Brush pile burns do not particularly favor Ribes establishment. Approximately 95 per cent of the area of a brush pile burn will not support Ribes growth. The balance of the burn, namely the part near the edges, where burning is usually light, sometimes supports Ribes. However, if Ribes are found near the edge of a burn, as many bushes can be found in the disturbed soil near by. The disturbance of the soil and duff by the fire and not the chemical change in the soil is probably responsible for the appearance of the seedlings near the burned edges.

Observations have shown that birds, rodents and deer eat the fruits of R. roezli, R. nevadense and R. cereum. Chipmunks harvest many of the fruits of R. roezli, eat the seed and pulp, and in some instances bury the whole fruits in the seeds or duff. Water erosion and man also assist in disseminating Ribes seeds. During logging operations logs are dragged over the ground for a distance of a quarter of a mile or more by tractors and donkeys. Late spring rains are frequently quite heavy and the runoff is rapid where logging or excessive grazing has occurred. The above factors assist in local dissemination of Ribes seeds and in some cases they may become agencies of distribution over long distances.

Quite often Ribes bushes are found growing near the edges of rocks or logs. Examinations of the root systems of some of these bushes have revealed that the roots grow under the rocks or logs. There are probably two reasons why the roots grow this way: (1) the rocks or logs furnish protection for the seedlings from frosts, excessive drying and animals; (2) the soil directly under any object in contact with the ground is kept moist for a good part of the season by the action of capillarity. The root systems of the plants naturally grow towards these places where more moisture is available.

SUMMARY

1. In sugar pine-fir and sugar pine-yellow pine types restocking by Ribes begins the second year after the timber is cut.

2. In stream type restocking by Ribes begins the first year after logging.

3. New Ribes will continue to appear on an area for at least 12 years after the timber has been cut.

4. On old logged-over areas where Ribes have been removed restocking by Ribes begins the year following.

5. Ribes seeds have been found in the top layer of loose needles, in

the compacted layer of duff and in the soil immediately beneath the compacted layer of duff.

6. The storage of Ribes seeds appears to be greater on moist slopes than on dry slopes.

7. When duff disturbances are reduced to a minimum, Ribes seed germination is correspondingly reduced.

8. When an area having old Ribes bushes is cut over some of the old bushes are left. They take on new life and produce many fruits.

9. Ribes seed germination has taken place prior to May 15 in 1930 and 1931.

10. Part of the seeds of the same fruit may germinate one year and part one year or more later.

11. Normal fruiting of Ribes bushes begins when the bushes are four years old, sprouts from old bushes fruit when they are two years old.

12. Stored seed is the source of new bushes on a cut-over area for the first three or four years.

13. Light burning favors Ribes seed germination but heavy burning does not.

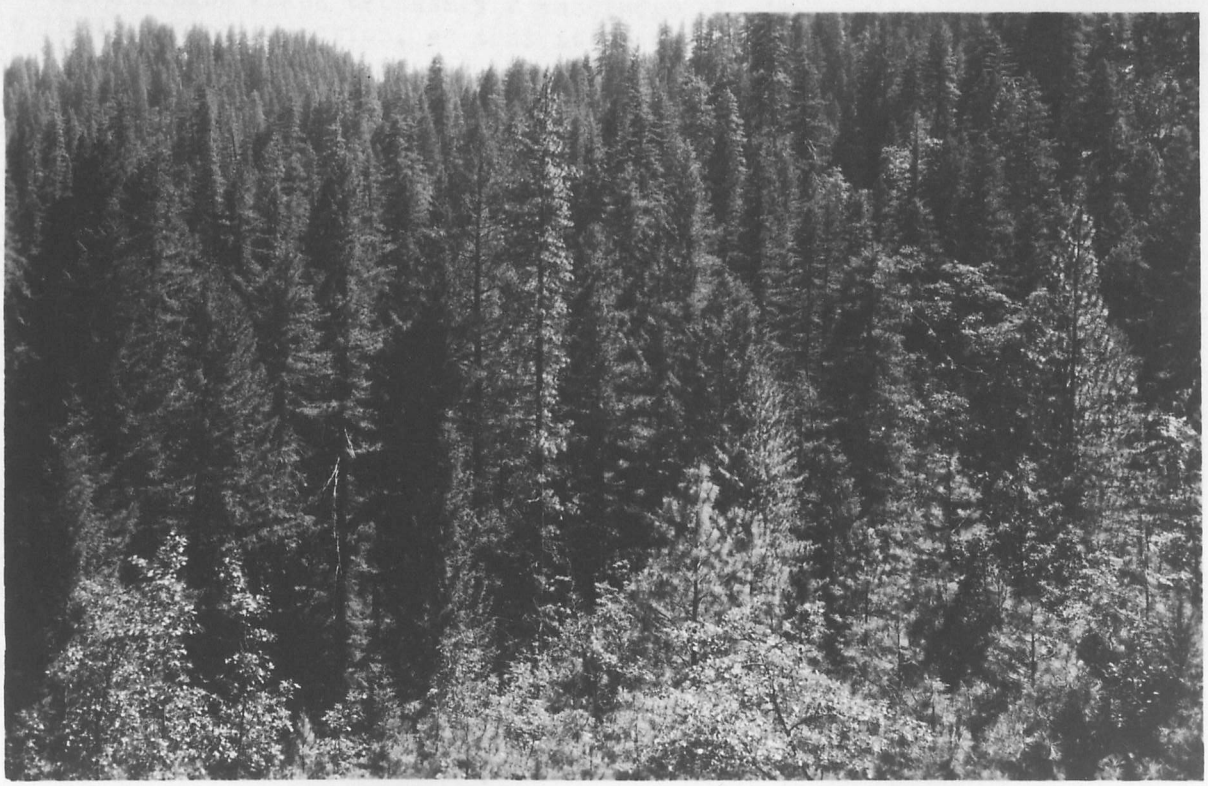
14. Brush pile burns are not as favorable to Ribes reestablishment as soil disturbances.

15. Burning ultimately increases the brush on an area, making the removal of Ribes more difficult.

16. Ribes seeds are distributed locally by birds, rodents, deer and man.



W. 993. Pure western white and sugar pine type along ridge above Bluff Creek. Klamath National Forest.



W. 994. Sugar pine, Douglas fir and yellow pine type along Horse Creek. Klamath National Forest.

CONTROL RECONNAISSANCE ON THE KLAMATH NATIONAL FOREST, CALIFORNIA, 1931

By
T. H. Harris,
Junior Forester

PURPOSE

In pursuance of the reconnaissance program in California, the Klamath National Forest in the northwestern corner of the state was covered by a general survey during the 1931 season. The sugar pine stands were located and type-mapped, and the Ribes conditions therein were recorded, so that the relation of these two to the spread and control of the white pine blister rust in this region may now be studied.

LOCATION OF THE WORK

A. Reason for Selection

The Klamath Forest contains stands of sugar pine not only valuable in themselves but which also would very likely become centers of infection along the northern border of the state from which the disease would spread to the more important stands of the south. The proximity of the rust in southern Oregon makes necessary a knowledge of pine and Ribes conditions in this strategic section, so that it seemed advisable for these reasons to conduct a reconnaissance of this forest.

B. General Description

On the north the Klamath Forest borders the California-Oregon state line; on the east, the Pacific Highway; on the south, the mountainous region of the Trinity National Forest; and on the west, a tongue of the Siskiyou Forest between the Klamath and the coast. The topography is broken and rough, the slopes are steep and rocky, and the ridges sharp. The Klamath River and its affluents, the Salmon and Scott Rivers, are the principal streams. The canyons of these rivers are the determining topographic features of the region.

Generally the timber is poor and scattered, particularly in the south, being of moderate height, poor form, and heavily infected with rot. In favored situations and in the Siskiyou Mountains north of the Klamath River good stands of timber occur. Fire everywhere has wrought havoc so that brush is omnipresent, not only in extensive fields but also as a dense ground cover beneath the timber. In the south, especially the Orleans district, brush and woodland are the major types of cover.

The tree that may be seen anywhere on the forest is Douglas fir (Pseudotsuga taxifolia), Usually it contains a high percentage of rot. Yellow pine (Pinus ponderosa), sugar pine (P. lambertiana), and white fir (Abies concolor) follow in abundance. Sugar pine is well distributed over the forest forming from 2 to 15 per cent of the stand; only in certain locations which were covered by reconnaissance does it exceed 15 per cent or show a quality sufficiently high to be merchantable. Trees which are found at elevations of 4,000 feet and over associated with one or more of those already named are: Shasta fir (A. magnifica shastensis), noble fir (A. nobilis), mountain hemlock (Tsuga mertensiana), western white pine (P. monticola), and Jeffrey pine (P. jeffreyi), Knobcone pine (P. attenuata) is a fire-type species occurring throughout the region, and Pord Orford cedar (Chamaecyparis lawsoniana) may be found in stream bottoms.

The woodland types of the lower elevations are characterized by these species: canyon live oak (Quercus chrysolepis), black oak (Q. kelloggii), Garry oak (Q. garryana), tanbark oak (Lithocarpus densiflora), madrone, (Arbutus menziesii), California laurel (Umbellularia californica), chinquapin (Castanopsis chrysophylla), and knobcone pine.

Brush consists of several species of Arctostaphylos and Ceanothus, of brush chinquapin (Castanopsis sempervirens), scrub tan oak (Lithocarpus densiflora var echinoides), huckleberry oak (Q. vaccinfolia), Sadler's oak (Q. sadleriana), salal (Gaultheria shallon), rhododendron (Rhododendron californicum), azalea (R. occidentale), red huckleberry (Vaccinium parvifolium), and bear brush (Garrya fremontii).

The common Ribes species found on upland and stream are Ribes lobbii, R. sanguineum, and R. cruentum. At the higher elevations R. viscosissimum, R. binominatum, and R. marshallii are present. R. lacustre, R. klamathense and R. bracteosum are stream type species.

C. Detailed Location of Operations

Reconnaissance disclosed the presence of four sizable bodies of pine, which because of differences in location, quality of timber, Ribes conditions within them, and the general control problem presented by each, have been treated separately in the compilation of data. A description of each of these follows:

1. The Laird Valley-Burrill Peak area lies within the Orleans Ranger District in the southern end of the forest. The stands are found in the Bluff Creek drainage on the ridges between Bluff Creek and Pecwan Creek, Bluff Creek and the Klamath River, and Bluff Creek and Camp Creek. The dense undergrowth of salal, rhododendron, huckleberry, tanbark oak, huckleberry oak, Sadler's oak, and chinquapin is typical of the coast country,

and is a result of this region lying within the fog belt. The larger streams are bordered by a zone of Douglas fir, Port Orford cedar, and woodland species with sugar pine absent.

The sugar pine is of medium height and only fair in quality; pine reproduction is good; the stands are open and scattered; brush is everywhere. The associated species are Douglas fir, white fir, and yellow pine, with the less important western white pine (on Onion Mountain), Port Orford cedar, chinquapin, tanbark oak, and knobcone pine. The woodland type described above is prevalent at lower elevations.

R. sanguineum, R. lobbii, R. cruentum and R. bracteosum constitute the Ribes flora. The susceptible R. bracteosum occurs in large quantities along the streams. The sugar pine types are relatively free from Ribes, as the summary for this country shows.

The topography is broken, steep and rocky. Elevations range from 1,500 to 4,800 feet.

2. The Elk Creek stands occupy the drainage of this stream approximately midway to the headwaters in the vicinity of Bear Creek. A packing trip of 16 miles south from Happy Camp is necessary to reach this unit.

The pine is confined to a narrow belt from 3,000 to 5,500 feet elevation, with good stands, limited in extent, occurring only from 3,500 to 4,500 feet. Individual trees of good form and size are scattered throughout the sugar pine types. Yellow pine is the chief associate, with Douglas fir prominent on the north slopes and creek bottoms. White and red fir dominate at higher elevations at the upper limit of pine growth. The region is moderately free from brush, the principal species being scrub oak and Ceanothus. The entire country was burned in 1925 so that reproduction is scarce. Slopes are exceedingly steep.

Ribes are plentiful, especially in the east drainage. The species are: R. sanguineum, R. lobbii, R. cruentum, R. lacustre, R. viscosissimum, R. binominatum, and R. marshallii. The three latter inhabit the fir types of high altitudes.

3. On Indian Creek, which flows into the Klamath at Happy Camp, in the drainage of the West Branch and between the West Branch and the South Fork are the best pine stands in this part of the forest. They occupy the southern and eastern slopes of the Siskiyou Mountains at elevations of from 3,500 to 5,000 feet. Ribes are few in the pine stands (one-third as plentiful as on Elk Creek) except along streams and at the upper altitudinal limit of the type within the fir belt where Ribes grow in the greatest profusion. The species are the same as those on Elk Creek. Slopes are less abrupt than in the two blocks previously discussed.

Included with Indian Creek in the summary is the ridge between Elk Creek and the Klamath River from Happy Camp south to roughly the sothern boundary of township 16 north, range 7 east, Humboldt Meridian. Similarity of Ribes conditions (bushes remarkably few) to those in Indian Creek rather than Elk Creek determined classification with the former. The sugar pine here is fair in quality and low in height. Slopes are exceedingly steep.

4. A belt of excellent sugar pine extending across three townships from the West Branch of Horse Creek on the west to the Hungry Creek-Cottonwood Creek divide on the east is known in this summary as the Beaver Creek-Horse Creek unit. The timber is found in the drainages of Beaver Creek and Horse Creek and their tributaries from 3,500 to 6,000 feet elevation on the southern slopes of the Siskiyou Mountains north of the Klamath River and bordering the state line. Sugar pine forms a good percentage of the stand, and is of fine quality with straight clear boles averaging two to five feet in diameter. With the exception of certain localities pine reproduction is good.

Parts of north Beaver Creek including the side streams of Hungry, Grouse, and Long John creeks, have been cut over since 1919 by the Fruit Growers Supply company which is still logging on Long John Creek. These lands are returning to yellow pine, white fir, Douglas fir, sugar pine, and brush; the percentage of sugar pine reproduction is still small.

Ribes are moderately abundant except on north Beaver Creek where a dense population is established. Along the streams R. lacustre grows prolifically, a little R. klamathense comes in on Hungry Creek, and on Middle Creek (an affluent of Horse Creek) R. bracteosum occurs. Upland species are the same as those found elsewhere.

Topography is more gentle than farther west in the Siskiyous or in the south. Brush is not dense.

Between one-third and one-half of the timber is Government owned; the Central Pacific Railroad owns roughly one-third, and the remainder is controlled by the Siskiyou-Minnesota Lumber Company, the Fruit Growers Supply Company, and the Bushow Lumber Company.

METHODS OF WORK

A. Field Methods

The mechanical framework of reconnaissance remained largely unchanged. Four strips thru each section, one through each forty, with eight one-tenth acre Ribes plots and eight similar sized timber plots per strip making a .5 per cent sample, together with timber type mapping

constituted the work in each section. Further details of this method fully explained may be found in the 1927 annual report under "Control Reconnaissance on Federal Lands, California."

While this method was used in unsurveyed and surveyed territory, in the former the difficulty of locating oneself had to be met. Upon entering a drainage in unsurveyed country the location of a point of origin for the survey was obtained by identifying a natural feature on the ground with the same on the map. This was usually a high point on a ridge, a lake, the confluence of two streams, or other natural feature. The sections shown on the maps, although they actually did not exist on the ground, were assumed to exist, and assumed section corners as points of origin for the strips were located by pacing from the known points. A number of known points were usually identified in a drainage and connected by pacing. In the case of the Elk Creek-Klamath River ridge it was impractical to use the system of superimposed sections because of the steep topography. Instead a chain and abney traverse was run along the summit and stations set every twenty chains from which strips were run west to the Klamath and east to Elk Creek.

Slopes adjacent to those worked by intensive reconnaissance were often type-mapped. These usually supported either no sugar pine at all or pine marginal in quantity and quality. This work is classified as extensive reconnaissance.

Type data secured by both the intensive and extensive methods were transferred to special topographic sheets which will be used by the California Forest Experiment Station in the preparation of "The Cover Type Map for the National Forests of Northern California."

A new system of type mapping was put into use, being that developed by the Forest Service for the map mentioned above. Several reasons prompted the change. First, under the new system type map material collected by the field party can be used directly by the Experiment Station for their map, without the necessity of re-mapping the same areas, a duplication of effort. Second in the northern Sierra Nevada the old system of timber types which had been adopted from the Forest Service of Region 5 in 1926 was admittedly inaccurate in depicting the true character and composition of the stands, and this disadvantage would have been increased in the Klamath country where the types are still more difficult to define. The new system gives as concise and true a picture of the composition of a stand as it is possible to attain when it is remembered that natural phenomena exhibit the finest nuances impossible to reduce to an arbitrary classification. Hence, in the interests of accuracy and cooperation this scheme was adopted. Its essentials are outlined in the following paragraph.

There are three principal classifications of cover types in the Experiment Stations's system of type mapping: 1. Treeless Land; 2. Woodland Types; and 3. Timbered Areas. The timber types, coming under "Timbered Areas", are named as nearly as possible from the species of trees composing the type in question, the symbol for each species which composes more than 20 per cent of the stand appearing in the type name. Thus "D" designates a stand of 80 per cent or more Douglas fir; "Y" - 80 per cent or more yellow pine; "Dw" - a stand of Douglas fir with more than 20 per cent of white fir; "Yd" - mixtures of yellow pine and Douglas fir, neither being present to the extent of 80 per cent; "Ydr" - mixtures of yellow pine, Douglas fir, and red fir, each entering the mixture to the extent of 20 per cent or more, and so on. The presence of sugar pine in quantities of 15 per cent or more is shown by prefixing "S" to the type symbol determined by disregarding the presence of sugar pine, thus "S.Yd" names a stand containing 15 per cent or more sugar pine and 20 per cent or more each of yellow pine and Douglas fir. This typing system is explained in detail in "Instructions for the Preparation of the Cover Type Map for the National Forests of Northern California" Forest Service, San Francisco, California, November 20, 1930.

For the first time the field maps were colored in the field to distinguish the various types, thus simplifying the jibing of the maps.

B. Office Procedure

The compilation of data according to four natural divisions has already been mentioned under "Detailed Location" above. The type data have been recorded on the regular township plots for permanent record. The same color legend was followed as that used for the cover type map of California. This legend given in full accompanies the township maps.

In the summary of data a consolidation of similar types was necessary to avoid confusion and to render the data clearly understandable. Hence, in the summaries "SP-YP" includes all types having sugar pine and yellow pine associated regardless of the presence or absence of any of the firs. Thus S.Y., S.Yd, S.Ydf, etc., all fall in this class. Similarly "SP-F" includes all types containing sugar pine associated with any combination of the firs as S.D, S.Dw, S.Ds, S.Df, S.Fw, S.F, etc. All types not classed as sugar pine, except "Brush", fall under "Non-SP". Obviously it would be impractical to summarize Ribes data for a large number of individual types so many of which are closely related, hence those showing a kinship of Ribes conditions were merged.

C. Personnel

The field work was accomplished by the project leader, five assistants, and a cook.

WORK PERFORMED AND RESULTS OBTAINED

The results of reconnaissance on the Klamath National Forest are given in the following tables:

TABLE NO. 1

SECTIONS WORKED IN WHOLE OR IN PART.
RECONNAISSANCE, KLAMATH NATIONAL FOREST, CALIFORNIA, 1931

Meridian	T.	R.	Intensive Reconnaissance	Totals		Extensive Reconnaissance	Totals	
			Sections by Number	Sec.	Acres	Sections by Number	Sec.	Acres
Humboldt	10 N	4 E	3-5, 21,22,27,28	7	4,150	3,16,20,26,29,34	6	2,880
	11 N	3 E	1	1	640	1,2,11-14	6	3,424
	11 N	4 E	1,2,4-7,12,13,28-34	15	8,024	3,4,8,10,11,18,19,30,31	9	4,696
	11 N	5 E	7,17,18	3	1,600	17	1	320
	12 N	3 E	23-26,35,36	6	2,880	22-24,27,34,35	6	2,880
	12 N	4 E	28,29,31-33,36	6	3,736	20,30,34,36	4	2,320
	14 N	7 E	1,2	2	960	2,3,12	3	1,600
	14 N	8 E	6	1	320	6,7	2	960
	15 N	7 E	35,36	2	960	2,3,25,35	4	1,600
	15 N	8 E	25,26,35,36	4	2,560	23,24,34	3	1,920
	16 N	7 E	22,23,26,27,34,35	6	3,407	14,15,23	3	193
	17 N	6 E	3,4,14,23,24	5	3,200	5,9-13,15,22,25,26	10	6,080
	18 N	6 E	10,12,15,16,21,22,28,33,34	9	5,440	1,2,10,11,20,27	6	3,520
	18 N	7 E				6,7	2	1,280
Mt. Diablo	44 N	12 W	7,18,19,30	4	2,560			
	47 N	8 W	2,3	2	1,280			
	47 N	9 W	3-5,8-16,21-23,26-29,31,32	21	14,336			
	47 N	10 W	7,16-23,26-30,33,34,36	17	9,408	17,23	2	640
	47 N	11 W	11-14,23,24	6	3,200			
	48 N	8 W	20,30,32-36	16	9,920			
	48 N	9 W	26-28,32-34	6	3,520			
Willamette	41 S	1 W	1-4,9-15	11	5,976			
	41 S	1 E	5-8,17,18	6	3,392			
Totals				156	91,469		67	34,313

TABLE NO. 2

SUMMARY OF EXTENSIVE RECONNAISSANCE

Types	Acres
SP-YP	1,799
SP-F	3,843
Non-SP	25,211
Brush	3,460
Total	34,313

TABLE NO. 3

RIBES ANALYSIS OF AREAS COVERED BY RECONNAISSANCE, KLAMATH NATIONAL FOREST, CALIFORNIA, 1931

PART A. LAIRD VALLEY - BURRILL PEAK

Types	Acres		Ribes Per Acre				
	No.	Percentage of Total	R. sang.	R. lobbii	R. cruant.	R. bract.	All Species
SP-YP	6,912	32.9	.3	.4	1.0	-	1.7
SP-F	6,657	31.7	4.6	4.7	3.6	-	12.9
Non-SP	5,103	24.3	1.2	4.9	22.5	.1	28.7
Brush	1,904	9.0	.3	-	.5	-	.8
Stream	454	2.1	27.0	8.5	89.3	154.4	279.2
Totals or Averages	21,030	100.0	2.5	2.9	8.9	3.3	17.6

TABLE NO. 3

PART B. ELK CREEK

Types	Acres		Ribes Per Acre							
	No.	Percentage of Total	R. sang.	R. lobbii	R. cruent.	R. lacustre	R. visco.	R. binom.	R. marsh.	All Species
SP-YP	2,600	35.3	19.2	19.5	24.5	-	-	-	-	63.2
SP-F	1,710	23.2	201.3	59.6	58.6	48.9	19.5	-	-	387.9
Non-SP	2,116	28.8	132.1	69.4	44.2	5.5	20.7	-	-	271.9
Brush	723	9.8	100.3	50.8	32.6	34.0	33.2	-	-	250.9
Stream	211	2.9	135.7	42.5	52.4	803.6	-	1.5	4.4	1040.1
Totals or Averages	7,360	100.0	105.3	46.9	39.7	39.3	13.7	.04	.12	245.1

TABLE NO. 3

PART C. INDIAN CREEK

Types	Acre		Ribes Per Acre							
	No.	Percentage of Total	R. sang.	R. lobbii	R. cruent.	R. lacustre	R. visco.	R. binom.	R. marsh.	All Species
SP-YP	1,940	16.1	1.0	-	7.9	-	-	-	-	8.9
SP-F	3,960	32.9	15.1	7.8	17.5	12.9	-	-	-	53.3
Non-SP	5,701	47.3	22.8	13.1	10.4	16.9	.5	.7	24.8	89.2
Brush	170	1.4	34.4	-	53.5	-	-	-	-	87.9
Stream	276	2.3	64.6	27.4	29.2	681.6	-	.03	-	802.8
Totals or Averages	12,047	100.0	17.9	9.4	13.4	27.8	.22	.31	11.8	80.8

TABLE NO. 3

PART D. BEAVER CREEK - HORSE CREEK

Types	Acres		Ribes Per Acre								
	No.	Percentage of Total	R. sang.	R. lobbii	R. cruent.	R. lacustre	R. visco.	R. binom.	R. klam.	R. bract.	All Species
SP-YP	15,147	29.7	1.5	22.2	12.0	1.6	3.2	.2	-	-	40.7
SP-YP CO	6,336	12.4	16.6	31.2	14.8	-	-	-	.2	-	62.8
SP-F	12,013	23.6	5.1	59.1	11.9	4.3	33.8	9.9	-	-	124.1
SP-F CO	732	1.4	102.6	89.9	3.4	-	-	-	-	-	195.9
Non-SP	10,859	21.3	1.2	41.7	6.4	7.6	25.0	52.7	-	-	134.6
Non-SP CO	2,357	4.6	45.6	25.1	5.2	1.0	2.6	-	-	-	79.5
Brush	450	.9	-	22.0	63.2	-	15.8	39.7	-	-	140.7
Brush CO*	965	1.9	55.0	65.4	-	-	8.0	-	-	-	128.4
Stream	1,599	3.1	39.5	35.3	8.5	576.1	4.3	12.1	3.9	3.7	683.4
Stream CO	574	1.1	97.5	41.8	4.9	479.9	-	-	24.7	-	648.8
Totals or Averages	51,032	100.0	10.9	38.5	10.5	26.6	14.7	14.2	.42	.01	115.8

*Originally this type was SP-YP and SP-F which reverted after logging to brush; it will not permanently be brush since timber reproduction is already noticeable.

TABLE NO. 3

PART E. SUMMARY OF ALL AREAS COVERED BY INTENSIVE RECONNAISSANCE
KLAMATH NATIONAL FOREST, CALIFORNIA, 1931

Types	Acres		Ribes Per Acre									
	No.	Percentage of Total	R. sang.	R. lobbii	R. cruent.	R. lacustre	R. visco.	R. binom.	R. klam.	R. bract.	R. marsh.	All Species
SP-YP	26,599	29.1	2.9	14.6	10.1	.9	1.8	.1	-	-	-	30.4
SP-YP CO	6,336	6.9	16.6	31.2	14.9	-	-	-	.16	-	-	62.8
SP-F	24,340	26.6	20.4	35.9	13.8	7.6	18.1	4.9	-	-	-	100.7
SP-F CO	732	.8	102.6	89.9	3.4	-	-	-	-	-	-	195.9
Non-SP	23,779	26.0	18.0	29.4	14.2	8.0	13.4	24.2	-	.02	6.0	113.2
Non-Sp CO	2,357	2.6	45.7	25.1	5.2	.9	2.6	-	-	-	-	79.5
Brush	3,247	3.5	25.8	13.9	16.5	8.1	9.2	3.5	-	-	-	77.0
Brush CO*	965	1.1	55.0	65.4	-	-	8.1	-	-	-	-	128.5
Stream	2,540	2.8	48.0	30.3	28.8	503.5	2.7	7.7	2.5	29.9	.4	653.8
Stream CO	574	.6	97.5	41.8	4.9	479.9	-	-	24.7	-	-	648.8
Totals or Averages	91,469	100.0	17.5	27.3	12.9	21.7	9.4	8.0	.2	.8	1.6	99.4

*Originally this type was SP-YP and SP-F which reverted after logging to brush; it will not permanently be brush since timber reproduction is already noticeable.

STATEMENT OF COSTS

The cost per acre of intensive reconnaissance (extensive reconnaissance was not figured since its cost is not separable from intensive) was $.04 obtained by dividing the total cost of the work by the number of acres covered intensively. This is slightly higher than the costs for the Sierran forests due to the roughness and inaccessibility of some of the areas worked which made packing necessary, and which, together with the running of control surveys, slowed down the work.

TABLE NO. 4

THE COST OF RECONNAISSANCE
KLAMATH NATIONAL FOREST, CALIFORNIA, 1931

Classification	Cost	Percentage of Total
Supervision and Labor		
Supervision, salary and expenses	$ 972.84	26.5
Salaries of assistants	1,513.34	41.2
Total	2,486.18	67.7
Subsistence*		
Cost of food	512.68	13.9
Transportation of food	62.54	1.7
Cook's salary	231.00	6.3
Total	806.22	21.9
Transportation**		
Transportation of men	47.64	1.3
Transportation of equipment	114.45	3.1
Scouting	114.08	3.1
Total	276.17	7.5
Equipment		
Cost of equipment	73.60	2.0
Storage of equipment	8.42	.2
Total	82.02	2.2
Miscellaneous Expenses	25.99	.7
Grand Total	$3,676.58	100.0

*Number of meals served.....1,988
Cost per meal.....$.40
**Total packing charges for the season.....$100.98

SUMMARY

On the Klamath National Forest a total of 91,469 acres of sugar pine and associated types have been covered by intensive reconnaissance at a cost of four cents per acre. Extensive reconnaissance netted 34,313 acres of types mostly non-sugar pine.

EXPERIMENTAL RIBES ERADICATION
LASSEN NATIONAL FOREST, CALIFORNIA, 1931

By
W. V. Benedict
Assistant Forester

PURPOSE OF WORK

The Lassen National Forest, situated at the northern end of the Sierra Nevada in northeastern California, was the scene of experimental Ribes eradication operations in 1931. The purpose of the project was to acquire additional data on the eradication of Ribes for the northern sugar pine region, such information to be used in the formulation of a blister rust control program for California. Previous eradication work in this region (that performed on the Plumas National Forest in 1929), while representative of a part of the sugar pine types for the Plumas Forest, was not sufficiently extensive to provide adequate information for the region as a whole. The Lassen Forest was selected for the experimental work because it contained extensive areas of sugar pine timber.

LOCATION AND DESCRIPTION OF AREA

The sugar pine stands of the Lassen Forest lie on the west slope of the Sierra Nevada at elevations ranging from 4,000 to 6,500 feet. Several streams, viz. Deer Creek, Mill Creek and Battle Creek, each flowing independently into the Sacramento River, have cut deep v-shaped canyons through the region. Between these streams are plateau-like areas with a westerly slope which support good sugar pine.

The area on which the 1931 eradication work was done is located on the plateau country between upper Deer Creek and Mill Creek in townships 27 and 28 north and ranges 4 and 5 east approximately 12 miles sutheast of the resort of Mineral. Figure 1 shows the various sections on which work was performed. The area is traversed on the northeast by the Red Bluff-Susanville Highway, and on the southeast by a secondary dirt road.

The topography of this region is generally quite regular and gentle except along Deer Creek and its tributaries where it becomes in places precipitous. The soil is largely of volcanic origin, with numerous outcroppings of lava rock.

The principal timber species present on the upper Deer Creek drainage are: sugar pine, western yellow pine, Douglas fir, white fir (Abies concolor), red fir (Abies magnifica) and incense cedar. These compose the stands in such varying percentages as to frequently make it extremely difficult to classify the timber types under the designations of sugar pine-



W. 972. Advance sugar pine reproduction in overmature sugar pine-fir type near Round Valley Ranger Station. Lassen National Forest.



W. 1048. Mature sugar pine-yellow pine type, Ribes free. Near Round Valley Ranger Station. Lassen National Forest.

yellow pine and sugar pine-fir so well defined in the southern Sierra Nevada. The sugar pine-yellow pine type usually consists of mature stands frequently open and park-like in appearance, while the sugar pine-fir type occurs in mixed age classes with several species of brush generally present.

While no pure brush type was encountered on the areas covered by eradication (except areas eliminated from crew work), portions of the area where fire had partially opened the timber stand were abundantly inhabited by different species of brush. The principal brush genera occurring on the area are: Arctostaphyllas (Manzanita) Ceanothus, Amelanchier, Castanopsis, Cornus, Prunus, Quercus and Salix.

The five species of Ribes native to the area, in the order of their abundance, are: Ribes roezli, R. nevadense, R. inerme, R. viscosissimum and R. cereum. As is shown in Table No. 1, each of these species occurs in all types. However, R. roezli is the most ubiquituous, growing on a wider variation of sites than the other species. R. nevadense and R. inerme while appearing in all situations, are largely confined to the streams and moist sites. R. viscosissimum and R. cereum are found infrequently and then chiefly at the higher elevations.

METHODS OF WORK

Two eradication camps, one containing 15 men and the other 20 men, each functioning independently with a camp boss in charge under the general supervision of the project leader, were operated this year. Supplies were purchased locally at Red Bluff and Mineral. Camp supplies, equipment and men were transported during the summer in government trucks.

In contrast to previous seasons of Ribes eradication in California no preliminary survey or pre-eradication work, other than what information could be had from control reconnaissance, was performed. Prior to field work the reconnaissance data for the area selected were utilized to formulate the season's eradication plans. A field map was prepared showing the extent and location of timber types (synonymous with eradication types except for the addition of stream type). Also, estimates were made as to cost and the amount of work needed to complete Ribes eradication for each square mile included in the eradication unit. Reconnaissance section summary sheets were taken into the field to assist the eradication men in allocating and planning crew work on individual sections. This information served as the working plan upon which the field work was organized.

In order to have a definite objective toward whihh to work and to serve as a measure for determining satisfactory work, a 50-foot per acre Ribes live stem limit was established as the criterion of an acceptable eradication job. All eradication work was required to conform

to this standard and to meet it one, and occasionally two, reworkings were frequently necessary. Sections, or convenient subdivisions, were used as working units. Before any crew work was undertaken each section was systematically stripped at 20-chain intervals and Ribes recorded as to location and number. These data, as well as the reconnaissance data for the section (which were also taken at 20-chain intervals, providing a 10-chain Ribes location survey of a section), were plotted on a working map. With this information the camp boss was able to intelligently organize crew work. Crews were sent into areas containing more than 50 feet of live stem per acre. Areas which, according to reconnaissance and check strip data, fell under 50 feet of live stem per acre were excluded from crew work. Such areas were further scouted by the camp boss to make certain no patches of Ribes were present. Any Ribes found were removed and the area eliminated from additional consideration.

For the most part three-man crews were used for all intensive work, exceptions being made in stream type where Ribes were especially abundant and larger crews could be used to advantage. Near the borders of Ribes-free areas and along narrow streams one and two men were used effectively in locating and eradicating the bushes. Each man was equipped with a pick-mattock Ribes tool. White sewing twine served to separate worked from unworked areas. Crews operated in a modified echelon formation, the spacing between men being varied according to the conditions of work and abundance of Ribes.

All work was checked just as soon as completed. A 2 per cent check of stream type and 1 per cent check of upland types was made. The checking work was done by the eradication supervisor and camp boss. Check strips 1/4-chain wide were used, so run as to best encounter average conditions. Missed Ribes were recorded by 2-chain transects along the check strip to enable eradication crews to readily locate any areas requiring reworking. Wherever reworking was necessary an additional check was made following the completion of the reworking. A second reworking was occasionally needed to reduce the Ribes live stem below 50 feet per acre.

Every precaution was taken to prevent sprouting. Eradication men were instructed to remove the Ribes crown and all of the root possible. However, past experience has shown that sprouting occurs in spite of precautionary measures. There are instances in rocky terrain where it is impossible to eradicate all of the roots. Also, some of the eradication men get negligent and leave bits of viable plant tissue. Sprouting, except in sites where working conditions are especially difficult, is not of alarming importance, seldom exceeding 5 per cent of the number of Ribes eradicated. (See page 210, 1930 Annual Report). Sprouting is a condition that must be accepted as a normal part of the California eradication operation and must receive special attention in follow up work. A satisfactory check for sprouts cannot be made during the current eradication season.

RESULTS OF WORK

The results of the eradication operation are shown in the following tabulations.

Figure 1 is a small-scale map of a segment of the Upper Deer Creek drainage of the Lassen Forest outlining by section the Ribes eradication area and depicting by color variations the general distribution of Ribes over the area. The accentuated portions of the streams represent stream type conditions where Ribes occurred in concentration, and intensive crew work was required. The green delimits upland areas where Ribes were numerous and intensive crew work was employed. The brown represents areas supporting only a scattering of bushes and were covered by extansive crew methods. The yellow portrays portions containing less than 50 feet of Ribes live stem per acre and were eliminated from crew work. The Diesel oil experimental area shown in red is located in the NE 1/4 of section 16.

As is shown in Figure 1, most of the Ribes were found along the streams and lower slopes, the higher slopes and ridge tops being Ribes free. Because of an overlapping of the two principal cover types, sugar pine-fir and sugar pine-yellow pine, making type classifications frequently difficult, there was a less marked contrast in Ribes occurrence in the two types in this region. Areas free of Ribes were almost equally divided between the two types, 4,393 acres of sugar pine-fir and 4,704 acres of sugar pine-yellow pine.

Sections lying east of the township line between ranges 4 and 5 east were worked from the Guernsey Creek camp and sections west of this township line were worked from the Round Valley camp. For purposes of comparison and analysis, the results of the work are shown, first, for the eradication operation as a unit and, second, for each camp individually.

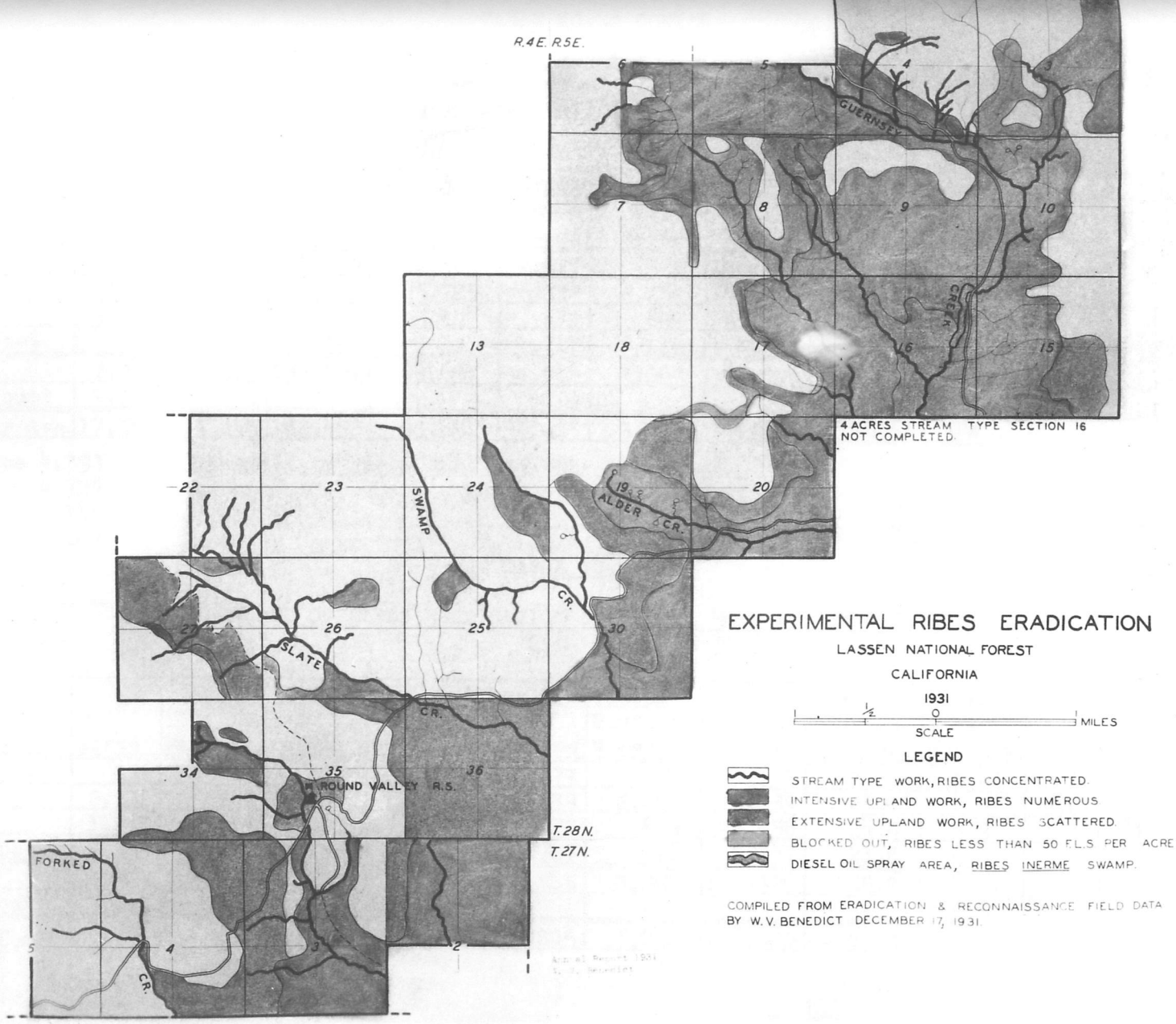

R.4E. R.5E.
GUERNSEY
CREEK
4 ACRES STREAM TYPE SECTION 16 NOT COMPLETED.
ALDER CR.
SWAMP
CR.
SLATE
CR.
ROUND VALLEY R.S.
T.28N.
T.27N.
FORKED
CR.
EXPERIMENTAL RIBES ERADICATION
LASSEN NATIONAL FOREST
CALIFORNIA
1931
½
0
MILES
SCALE
LEGEND
STREAM TYPE WORK, RIBES CONCENTRATED.
INTENSIVE UPLAND WORK, RIBES NUMEROUS
EXTENSIVE UPLAND WORK, RIBES SCATTERED.
BLOCKED OUT, RIBES LESS THAN 50 F.L.S PER ACRE
DIESEL OIL SPRAY AREA, RIBES INERME SWAMP.
COMPILED FROM ERADICATION & RECONNAISSANCE FIELD DATA
BY W.V. BENEDICT DECEMBER 17, 1931.

Figure 1

TABLE NO. 1

SUMMARY OF RIBES ERADICATION BY TYPES (BOTH CAMPS)

Types	Acres	Man Days	Ribes Eradicated R. roezli	R. nevadense	R. inerme	R. visco. R.cereum	Total	Ave. No. Bushes Per Acre	Acres Per Man Day	Costs Per Type	Costs Per Acre
Stream	338	636.3	21,099	62,445	52,577	38	136,159	402.8	.53	$ 3,653.94	$10.81
SP-F	4,263	785.1	113,190	25,725	339	2,254	141,508	33.3	5.40	4,509.12	1.06
SP-YP	3,007	419.2	47,975	5,195	172	649	53,991	18.0	7.20	2,410.04	.80
Minor Types	383	58.9	6,188	326	1,717	116	8,347	21.8	6.50	333.19	.87
Subtotal	7,991	1,899.5	188,452	93,691	54,805	3,057	340,005	42.50	4.20	$10,906.29	$ 1.36
Blocked out*	9,349	34.0	-						275.00	199.91	.02
Totals or Ave.	17,340	1,933.5	188,452	93,691	54,805	3,057	340,005	19.6	8.96	$11,106.20	$ .64

*SP-F Type 4,393
SP-YP " 4,704
Minor " 145
Brush 107

TABLE NO. 2

SUMMARY OF RIBES ERADICATION BY TYPES, PART A. GUERNSEY CREEK CAMP

Types	Acres	Man Days	Ribes Eradicated R. roezli	R. nevadense	R. inerme	R.visco. R.cereum	Total	Ave. No. Bushes Per Acre	Acres Per Man Day	Costs Per Type	Costs Per Acre
Stream	157	350.5	5,027	16,496	52,577	33	74,133	472.2	0.4	$2,103.38	$13.40
SP-F	2,832	438.8	56,397	20,294	339	2,254	79,284	28.0	6.5	2,635.72	.93
SP-YP	1,933	218.4	23,915	3,820	172	649	28,556	14.8	8.9	1,311.37	.68
Minor Types	383	58.9	6,188	326	1,717	116	8,347	21.8	6.5	357.05	.93
Subtotal	5,305	1,066.6	91,527	40,936	54,805	3,052	190,320	35.9	4.97	$6,407.52	1.21
Blocked out	3,635	14.0	-	-	-	-	-	-	259.6	84.39	$ .02
Totals or Ave.	8,940	1,080.6	91,527	40,936	54,805	3,052	190,320	21.3	8.3	$6,491.91	$ .73

TABLE NO. 2 CONT'D

SUMMARY OF RIBES ERADICATION BY TYPES, PART B, ROUND VALLEY CAMP

Types	Acres	Man Days	Ribes Eradicated					Ave. Bushes Per A.	Acres Per Man Day	Costs	
			R. roezli	R. nevadense	R. inerme	R.viscosissimum R. cereum	Total			Per Type	Per Acre
Stream	181	285.8	16,072	45,949	-	5	62,026	342.7	0.6	$1,545.79	$8.54
SP-F	1,431	346.3	56,793	5,431	-	-	62,224	43.5	4.1	1,873.40	1.31
SP-YP	1,074	200.8	24,060	1,375	-	-	25,435	23.7	5.3	1,088.97	1.01
Subtotal	2,686	832.9	96,925	52,755	-	5	149,685	55.7	3.2	$4,508.16	1.68
Blocked Out	5,714	20.0	-	-	-	-	-	-	-	106.13	.02
Totals or Ave.	8,400	852.9	96,925	52,755	-	5	149,685	17.8	9.8	$4,614.29	$ .55

TABLE NO. 3

SUMMARY OF RIBES ERADICATION - PERCENTAGE OF TOTALS

Types	Guernsey Creek Camp			Round Valley Camp			Both Camps		
	Acres Per Cent	Ribes Per Cent	Costs Per Cent	Acres Per Cent	Ribes Per Cent	Costs Per Cent	Acres Per Cent	Ribes Per Cent	Costs Per Cent
Stream	1.7	39.0	32.4	2.2	41.4	33.5	1.9	40.0	32.9
SP-F	31.7	41.6	40.6	17.0	41.6	40.6	24.6	41.6	40.6
SP-YP	21.6	15.0	20.2	12.8	17.0	23.6	17.3	15.9	21.7
Minor Types	4.3	4.4	5.5	-	-	-	2.2	2.5	3.0
Subtotal	59.3	100.0	98.7	32.0	100.0	97.7	46.0	100.0	98.2
Blocked out areas:	40.7	-	1.3	68.0	-	2.3	54.0	-	1.8
SP-F	10.9			40.7			25.4		
SP-YP	28.2			26.0			27.2		
Minor	1.6			-			.8		
Brush	-			1.3			.6		
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0



W. 982. Stream type along Round Valley Creek. R. nevadense abundant.



W. 980. Swamp stream type along Deer Creek. R. inerme abundant. This area sprayed with Diesel oil.

Chemical Eradication

Ribes inerme concentrations were encountered along parts of Guernsey Creek of sufficient density and magnitude as to preclude the ordinary handpulling and grubbing methods of eradication. As an entirely experimental undertaking Diesel oil was used as a spray to leaves, stems and crowns, and as a soil drench on sixteen acres of the heaviest R. inerme. Each bush was treated with a heavy application of oil spray to both surfaces of leaves and to stems and soil at base of crown. A check-up on the work late in the season showed that although a high percentage of live stem was killed the percentage of bush kill was low. Sprouting from the crown was abundant. A respray job was performed on part of the area, oil being applied copiously to the young sprouts and surrounding soil. A check-up of this area in 1932 will be necessary before final results on the use of Diesel oil can be determined.

Diesel oil was also applied to 1/2-acre of heavy R. roezli. A check of this area late in the season showed no evidence of sprouting. Indications are that Diesel oil will prove much more effective on R. roezli than on R. inerme. Soil moisture at the time of application of oil is an important factor in determining the degree of success oil sprays will provide. The drier the soil the better the chances of complete plant kill.

The cost of the oil spraying experiment, excluding supervision and equipment charges, amounted to $279.62 or $16.95 per acre. A total of 1,475 gallons of Diesel oil (89-1/2 gal. per acre) were used.

Fire Fighting

From late July until the blister rust camps closed September 18 especially hazardous fire conditions prevailed on the Mineral Ranger District of the Lassen Forest. During this period blister rust crews were used to assist in suppressing nine forest fires, 384 man days being spent on fire duty. Forest officers of the Lassen were at all times cognizant of the objectives of the blister rust program and interrupted the operation as little as possible. Blister rust men were released from fire duty immediately upon control of a fire.

STATEMENT AND ANALYSIS OF COSTS

Costs incurred by the eradication field operation during 1931 are itemized in Table No. 4. Figures in this tabulation were used in deriving all acreage cost figures shown in this report. Costs for the different timber types were computed on the basis of man days spent in each type.

TABLE NO. 4

FIELD EXPENDITURES, MAY 1 TO SEPT. 30

Expenditure Classification	Guernsey Creek Camp	Round Valley Camp	Both	Per Cent of Tot. Cost
Supervision	$ 591.24	$ 466.43	$ 1,057.67	9.5
Labor	3,590.47	2,661.17	6,251.64	56.3
Subsistence*	1,895.69	1,160.19	3,055.88	27.5
Transportation of Men	59.26	46.25	105.51	1.0
Transportation, Misc.	26.11	20.59	46.70	.4
Supplies	85.30	67.30	152.60	1.4
Equipment	228.38	180.16	408.54	3.7
Miscellaneous	15.46	12.20	27.66	.2
Totals	$6,491.91	$4,614.29	$11,106.20	100.0

*162 meals @ $.3369 ($54.58) deducted from Guernsey Creek Camp and added to Round Valley Camp, necessitated by reworking Round Valley area by Guernsey Creek crews.

TABLE NO. 5

SUBSISTENCE COSTS

Subsistence Classified	Guernsey Creek Camp	Round Valley Camp	Both	Meal Cost
Number of Meals Served	5,788	3,543	9,331	-
& Staple groceries	$1,015.75	$ 547.23	$1,562.98	$ .168
Fresh meat	203.92	124.70	328.62	.035
Fresh vegetables	124.64	72.69	197.33	.021
Total food	$1,344.31	$ 744.62	$2,088.93	$ .224
Cook's wages	549.80	316.67	866.47	.093
Transportation	56.16	44.32	100.48	.011
Totals	$1,950.27	$ 1,105.61	$3,055.88	$ .328
			Guernsey Cr. Camp	.337
			Round Valley Cp.	.311

CONCLUSION

During the past field season 340,005 Ribes were eradicated from 17,340 acres of sugar pine timber on the Lassen National Forest at a cost of $11,106.20. This is an average of 19.6 Ribes per acre and an average eradication cost of $.64 per acre. The area worked this season contained fewer Ribes and was covered at less cost than any area on which Ribes eradication has thus far been performed in California. Cost figures obtained this season, although quite representative of the Lassen Forest, probably represent the minimum for the sugar pine region as a whole with the methods in use at present.

Methods of work, in so far as crew formations are concerned, varied little over those of previous seasons. Special attention was given to organizing crew activities to best meet working conditions. Wherever possible crews were kept out of areas free from Ribes. Control reconnaissance data, augmented by similar data secured by eradication men, were used to plan the eradication job. This procedure, which supplanted previous pre-eradication practice, worked out fully as satisfactory as pre-eradication, and its continued use in California is recommended.

PART I

INVESTIGATIVE WORK IN THE CHEMICAL ERADICATION OF RIBES

By
G. R. Van Atta
Agent

INTRODUCTION

Laboratory and field studies concerning the toxicity of various chemicals to Ribes have been continued. Laboratory work has been conducted both at the University of California in Berkeley and in the laboratory established last year at the University of Idaho in Moscow. As in former years, the work has been in the fields of chemistry, physiology, and morphology.

In addition to the investigations herein reported with special references to Ribes, a like program has been carried on in the laboratory and field designed for the development of suitable methods for the eradication of the common barberry with the aid of chemicals. Whenever possible, the results of research in either of these two divisions of the work have been applied to both problems.

In the field, much emphasis has been placed upon experiments designed for the purpose of developing satisfactory methods for the eradication of R. inerme with chemicals. This hardy species, growing as it does in great profusion in moist locations throughout the forested regions of the Inland Empire, and also occurring in the sugar pine regions of California, has shown itself to be particularly resistant to eradicative efforts. In the Inland Empire, besides the work with R. inerme and in addition to attempts to improve present methods for the eradication of R. petiolare, experiments have been performed with R. lacustre, R. watsonianum, R. bracteosum, and R. erythrocarpum. Further effort has been put forth in California to discover suitable chemical methods for the eradication of R. roezli, R. nevadense, and R. cereum.

During the regular course of the laboratory work, the findings of the individual research assignments are from time to time made the subject of special reports for publication or office reference. Attention is called to United States Department of Agriculture Technical Bulletin No. 240 on "The Chemical Eradication of Ribes," published in May of this year. The earlier investigative work is summarized in this publication by H. R. Offord. In keeping with past practice only a brief summary of the research work will be given at this time. For more comple te information on these subjects, attention is directed to the aforementioned separate repor ts.

Acting upon indications given by research and field experience, preliminary field experiments were performed in 1930 aimed at the development of chemical methods for the eradication of the more resistant Ribes species by other means than the application of chemicals as aqueous sprays to the aerial parts of plants. The results of these 1930 field experiments and further laboratory work led to the adoption of a field program for 1931 in which considerable emphasis was placed upon studies involving methods of chemical application new to the work.

The 1931 field experiments covered by this report include the use of chemicals in the five following ways: (1) Sprays of aqueous solutions or oils applied to aerial plant parts: (2) surface soil drenches of either aqueous solutions or oils applied to the ground about the bases of the plants; (3) subsurface soil drenches of aqueous solutions applied four to ten inches below the surface of the ground about the plants; (4) injection of chemicals in the form of pastes into the stems, crowns, or roots of the plants; and (5) dust applied to the aerial plant parts. In some instances combinations of certain of the foregoing methods of application were used.

An extensive program of experimentation planned for the purpose of studying the movement of foreign substances after they have been introduced into the body of the plant was begun in the field this year. In these experiments chemicals were applied in several ways to severed or split stems and roots. This work was designed primarily to aid in the discovery of the possibilities and limitations of a number of methods of application rather than as a trial of the particular methods of treatment employed in the individual experiments. The findings of this work will only become available after certain laboratory work now in progress is finished. A separate report covering the subject will then be submitted.

SUMMARY OF RESEARCH WORK 1930 - 1931

A. Chemical

1. Starch analyses of Ribes. Over 300 analyses have been completed on eight western species of Ribes. The results place the species concerned in approximately the following order of decreasing starch content: R. inerme, R. lacustre, R. viscosissimum, R. bracteosum, R. roezli, R. petiolare, R. nevadense, and R. erythrocarpum. A study of seasonal variation shows that as the growing season advances the starch level is subject to a marked rise in all the species studied. Local environment is also reflected in the quantity of starch found in various plants. For these reasons, too great dependence should not be placed upon the exact order of the various species in the list given above. The position of R. inerme at one end of the list as compared to that of R. petiolare,

which is well down toward the other end, is in agreement with field observations regarding the ability of these two species to combat the toxic effects of chemical treatments.

2. Tannin determinations. Over 90 tannin determinations completed this year on Ribes samples place the plants in the following order of decreasing tannin content: R. petiolare, R. erythrocarpum, R. nevadense, R. roezli, R. lacustre, R. viscosissimum, R. bracteosum, and R. inerme. The order in which several of the species appear in this list is a complete reversal of the order in which they were formerly placed upon the basis of samples analyzed in previous years. Tannin content of plants is notoriously variable in response to environmental circumstances, as is also starch content, and, in order to properly evaluate the figures given by either starch or tannin analyses, knowledge of the environment of the plants from which the samples were collected should be at hand. Unfortunately, this point was not fully realized at the time the collections were made and complete information of this kind is not available for all the samples analyzed.

3. Chemical pastes. Field experiments performed in 1930 suggested the need for chemicals in the form of pastes to be used for injection into the stems, roots, and crowns of plants as a means of administering toxic substances. Since the chemicals to be used are practically all freely soluble in water, it is impossible to prepare permanently smooth pastes of the chemicals and water only. Admixture of the chemicals with various liquids showed that, under certain circumstances, permanently smooth pastes could be made by using dry chemicals and glycerine. This process, which is the subject of a separate report, demands the use of special apparatus for heating, cooling, and stirring the mixtures.

4. Flameproofing cloth. The Division of Blister Rust Control has long recognized the hazards of injury to workmen through clothing fires occasioned by the accumulation of chlorates upon wearing apparel used while applying chlorate sprays. In order to safeguard against accidents from this cause, a process was worked out several years ago for flameproofing and partially waterproofing articles of clothing. This work is the subject of Public Service Patent No. 1,821,371 recently granted to H. R. Offord and N. T. Mirov of the Berkeley laboratory. Since the application for patent was made it was found that certain details of the process could not be easily accomplished on a large scale. In order to obviate these difficulties, the Berkeley laboratory has completed a number of further experiments. The results of this work have made practical, in large-scale operations, the use of the basic ideas involved in the original work. After a preliminary trial on a small-plant scale, an order was placed with two Eastern firms calling for the treatment of a quantity of cloth sufficient to afford an adequate test of garments to be

made from it and worn in the field. The order was filled too late in the field season to permit of a field test this year.

5. Design of paste injection tool. In the 1930 field experimental work injections of chemicals as aqueous solutions and as aqueous pastes were made into the stems and crowns of Ribes plants by a number of very laborious hand methods. If further trial of the principle of injection was to be made, a tool was needed for the 1931 field season which would accomplish the process more expeditiously than could hand labor. A design for such a tool was drawn in the Berkeley office and two tools were made according to the plan. These were used in the 1931 field experiments reported herein.

B. Physiological

Greenhouse experiments performed at Moscow with chlorates have shown that in extremely low concentrations (0.1 to 0.5 per cent) sodium chlorate is slightly more toxic to Ribes plants than mixtures of this chemical with calcium chloride. This difference between the effects produced by aqueous solutions of sodium chlorate and solutions of sodium chlorate-calcium chloride mixtures of the same concentrations by weight is not constant. Thus, it disappears almost entirely when the concentration lies between the limits of approximately 5 and 10 per cent by weight and reappears when the quantity of chemical per unit volume of water is still further increased. Additional information upon this subject is given in Figure 1, Table No. 5, and the accompanying text. Other experiments with Ribes growing in culture solutions showed that concentrations of sodium chlorate as low as 50 parts per million parts of culture solution were lethal to R. petiolare in three and one-half months. R. lacustre was killed in the same length of time by a concentration of 100 parts per million, while the R. inerme plants did not die in that length of time unless the concentration of the chemical was at least as high as 250 parts per million.

Many other experiments besides those mentioned in the foregoing were performed for the purpose of testing the toxicity of a large number of chemicals including such substances as ethylene oxide and ammonium thiocyanate. These researches are the subject of separate reports which should be consulted for further information.

C. Morphological

During the course of the year reports have been prepared covering the various aspects of the morphological work undertaken at Berkely. No attempt will be made to give an adequate summary of these investigations in this report. Such a summary, however, is at present in the course of preparation and will soon be submitted as a separate report.

Following is a list of morphological characteristics of leaves that have been studied: Stomatal size and frequency, hydathode size and frequency, thickness of epidermal cells and epidermal cell walls, ratio of thickness of palisade layer to total leaf thickness, measurements of trichome length and frequency, length of midrib, and distance between lobes. Attempts have been made to correlate these morphological features of Ribes with resistance to chemical treatment by comparing them with the corresponding features characteristic to certain brush species. The brush species examined occur in association with Ribes and their resistance to chemical treatment is known through field experience. Following is a partial list of the plant species examined:

Ribes bracteosum
Ribes cereum
Ribes erythrocarpum
Ribes inerme
Ribes lacustre
Ribes lasianthum
Ribes nevadense
Ribes petiolare
Ribes roezli
Ribes viscosissimum
Ribes watsonianum
Alnus tenuifolia
Amelanchier alnifolia
Arctostaphylos patula
Castanopsis sempervirens
Ceanothus cordulatus
Ceanothus integerrimus
Cornus stolonifera
Salix sp.

Morphological work of like nature to that performed with the plants listed above was also done upon Berberis vulgaris in connection with the work described in Part II of this report.

D. Ribes Garden at Berkeley

For some time in the past the Berkeley laboratories have felt a need for a permanently maintained stock of Ribes plants adequate to supply at all times satisfactory plant material for research work. It has not always been possible to obtain a sufficient stock of field plants for culture in the greenhouse, and in some instances the morphological work has been handicapped by the lack of proper plant material. It was also felt that if growing plants representing some of the Ribes species not ordinarily encountered in blister rust control work were at hand and

available for study, additional information valuable to the conduct of control work could be obtained. An attempt to satisfy these needs has resulted this year in the establishment of a permanent Ribes garden near the campus of the University of California at Berkeley. An agreement was made in 1930 with the Botany Department whereby a portion of the land owned by the University in Strawberry Canyon, which adjoins the campus, will be devoted to the culture of Ribes plants. In return for the use of the land, the Botany Department will have access to the plants for academic uses.

The size of the Ribes garden at present is slightly less than one-third of an acre. Following is a list of the Ribes plants which have already been collected and planted in the new garden:

Species	Number of Bushes
R. amarum	2
R. californicum	7
R. canthariformis	3
R. cereum	1
R. gracillimum	3
R. hesperium	2
R. hystrix	5
R. indecorum	2
R. inerme	5
R. lacustre	5
R. lasianthum	3
R. malvaceum	1
R. nevadense	1
R. parishii	5
R. petiolare	4
R. quercetorum	7
R. roezli	6
R. senile	4
R. sericeum	2
R. speciosum	3
R. viscosissimum	5

Attempts will be made to grow specimens for the garden from seed. The seeds to be used will be principally from species native to distant localities. Following is a list of seed collections now at hand for this purpose. The localities and dates of collections are also given.

List of Seed Collections on Hand at Berkeley, November 1, 1931

Collection No.	Species	Locations and Dates of Collections
26	R. alpinum	Germany, 1931
1	R. aureum (black fruit)	Oregon, 1927
2	R. aureum (yellow fruit)	Oregon, 1927; California, 1931
3	R. binominatum	Oregon, 1927
4	R. bracteosum	Oregon, 1927
5	R. cereum	Oregon, 1927; California 1930-31
6	R. cruentum	Oregon, 1927
6a	R. cynosbati	New Hampshire, 1931
7	R. erythrocarpum	Oregon, 1927
26a	R. grossularia	Germany, 1931
7a	R. hirtellum	New Hampshire, 1931
7b	R. hudsonianum	Michigan, 1931
8	R. inerme	Idaho, 1927; California, 1930-31
9	R. irriguum	Oregon, 1927
10	R. klamathense	Oregon, 1927
11	R. lacustre	Oregon, 1927; Idaho, 1927
12	R. lasianthum	California, 1930-31
13	R. lobbii	Oregon, 1927
14	R. marshallii	Oregon, 1927
14a	R. missouriense	Wisconsin, 1931
15	R. montigenum	California, 1930-31
16	R. nevadense	California, 1929-30-31
17	R. nevadense (from bird dung)	California, 1930
18	R. niveum	Washington, 1927
19	R. petiolare	Idaho, 1927; Oregon, 1927
20	R. roezli (red fruit)	California, 1929-30-31
21	R. roezli (yellow fruit)	California, 1930-31
26b	R. rubrum	Germany, 1931
22	R. sanguineum	Oregon, 1927
22a	R. glutinosum	California, 1931
23	R. velutinum	Oregon, 1927; California, 1931
24	R. viscosissimum	Idaho, 1926; Oregon, 1927
25	R. viscosissimum var. hallii	California, 1930
25a	R. watsonianum	Washington, 1931; Oregon, 1931

When specimens of the various species are once established it will be possible to propagate additional plants for use in the laboratory by means of stem cuttings. This method of culture will make possible a material reduction in the troublesome factor of variability between the specimens used in research.

It is planned to group the various Ribes plants in the garden according to the subgenera to which the individuals belong. The plan is as follows:

Ribes Groups

(Arranged according to Janczewski's classification by subgenera.)

Group No.	Subgenus	Description
1	Ribesia	Contains R. vulgare, the cultivated red currant, also R. triste, R. petraeum, etc.
2	Coreosma	Group contains about 30 species classified in seven groups within the subgenus. Examples of species: R. nevadense, R. viscosissimum, R. petiolare, etc.
3	Grossularioides	Very small but well defined group. Two species; R. ladustre and R. montigenum.
4	Grossularia	Large group, about 40 species. This subgenus is divided into two groups. Example: R. roezli, R. cynosbati, R. missouriense, R. watsonianum, etc.
5	Parilla	Large groups of dioecious species native mostly to tropical places and South America.
6	Berisia	Small dioecious group native mostly to Asia.

SUMMARY OF 1931 FIELD EXPERIMENTS

A. Recheck of 1930 Experiments in Idaho, California, and Oregon

Experimental plots of 1930 at Santa and Clarkia, Idaho, were checked by R. P. d'Urbal, R. W. Vance, L. S. Keyser, and L. C. Pense according to the established method of ocular estimates. C. A. Bickford also assisted at Santa. Tables No's. 1, 2, and 3 are records of the data thus obtained. The 1930 experimental plots in the Stanislaus National Forest, California, were checked by C. R. Quick, J. A. Vogtmann, and

G. R. Van Atta. The figures representing the California check are reported in Table No 4, which includes data taken from certain experimental plots that were laid out and treated in 1930 under the direction of W. V. Benedict. The results of this particular series of experiments are valuable to this report for the information they yield relative to the use of oils upon R. roezli. Details regarding the treatments given the Ribes on these plots are to be found in the 1930 annual report for Project 2.25. The experimental treatments performed in Oregon during 1930 were checked by R. P. d'Urbal and in part by G. R. Van Atta. The results of the Oregon check are given in Table No. 6.

Crown and stem treatments in Idaho, California, and Oregon: The crown and stem treatments reported in Tables No's. 2, 4, and 6 were the first of their kind attempted in the field, and were in the nature of orientation or preliminary experiments. All of the methods of application used in these trials were very laborious, and, as a consequence, the number of plants treated was quite small. Interpretation of the results of these experiments is limited to the following observations:

1. The application of toxic substances to cut plant parts close to the tops of the roots markedly increases the chances for kill by some chemicals beyond the limits achieved by the application of sprays of the same materials to the aerial parts.

2. Arsenic oxide, pitch oil, and salts of such metals as copper and silver were relatively the most effective substances used in these experiments. It is doubtful, however, whether the pitch oil functioned more by reason of contact with cut parts or by contact with adjacent intact parts. Further discrimination with regard to materials is impossible on the basis of these tests alone.

3. The extent to which the effect of the chemicals was distributed through the plant was quite erratic, sometimes being astonishingly great while at other times it was confined almost entirely to the point of application.

4. All the methods of application that were tried were very imperfect both as regards time consumed and uniform efficiency of treatment.

Crown drenches in Idaho and California: Special efforts were made during 1930 in both Idaho and California to treat the basal portions of Ribes plants with drenches of oils or aqueous solutions of chemicals. The results of these experiments are given in Tables No's. 3 and 4.

TABLE NO. 1

RESULTS OF 1930 EXPERIMENTAL SPRAYING AT SANTA, IDAHO. DATA TAKEN 1931

Plot Number	Chemical Used	Concentration in Parts by Volume or Pounds Per Gallon H_2O	pH of Spray	Gallons Spray Used	Per Cent Live Stem Kill	Per Cent Bush Kill
III A (2-3)	Pitch Oil (1)	As Furnished		6	80.2	16.7
III A (6-6.6)	Pitch Oil + Pyridine	100 Parts 1 Part		2	88.8	4.0
V A (1-2)	Pitch Oil + Furfural	20 Parts 1 Part		2	78.0	7.8
V B (2-2.3)	Pitch Oil + Toluene	50 Parts 1 Part		1	91.8	31.6
V B (2.3-3)	Pitch Oil + Benzene	50 Parts 1 Part		1	78.0	0.0
V A (2-3)	Pitch Oil + Naphthalene	50 Parts 1 Part		1-1/2	84.6	0.0
I B (3-4)	X (2)	2.06 Pounds	10.0	5-1/2	35.0 *25.0	No Record No Record
I B (4-5)	X + Glue	2.6 Pounds 0.02 Pounds	10.0	4-1/2	45.0 *15.0	No Record No Record
IV B (1-2)	Pitch Oil + Cresylic Acid	50 Parts 1 Part		2	No Record	No Record
IV A (3-4)	Pitch Oil + Phenol	50 Parts 1 Part		2	38.0	2.4
III B (6-6.3)	Cadmium sulphate + Glycerine	.25 Pounds .02 Pounds	6.5	2	35.4	0.0
III B (6.3-6.6) and II B (5-5.6)	Cadmium chloride + Glycerine	.25 Pounds .02 Pounds	6.5	2	48.1	0.0
Opposite B (1-2)	Silver nitrate + Sodium thiosulphate	.45 Pounds 4.2 Pounds		1/4	29.9	0.0
Opposite VIII B (1-2)	Silver nitrate	.45 Pounds		1/4	11.1 *28.6	0.0 0.0
Ex. 1	A + Buffer (3)	.45 Pounds	4.0	6	99.0	91.5
Ex. 2	A	.45 Pounds	6.0	6	99.5	87.5
Ex. 3	A + Buffer (3)	.45 Pounds	4.0	6	99.5	77.0
Ex. 4	A + Buffer (4)	.45 Pounds	5.0	6	99.5	86.0
Ex. 5	A + Buffer (3)	.89 Pounds	4.0	6	99.9	96.5
Ex. 6	A	.89 Pounds	6.0	6	99.5	85.5
Ex. 7	A + Buffer (4)	.89 Pounds	5.0	6	99.9	90.5
Ex. 8	A + Buffer (5)	.45 Pounds	9.0	6	99.5	88.5
Ex. 9	A + Buffer (5)	.89 Pounds	9.0	6	98.2	65.5
Ex. 10	Atlacide and Buffer (3)	3.0 Pounds	4.0	6	24.0	0.0
Ex. 11	Atlacide and Buffer (4)	3.0 Pounds	5.0	6	25-30	0.0
X A (4.7-5)	Diesel Oil (6) + Pitch Oil	2 Parts 1 Parts		3	91.3	10.0
X B (3.9-5)	Diesel Oil +Pitch Oil	3 Parts 1 Part		2	89.1	15.2
X A (2.6-4.7)	Diesel Oil + Pitch Oil	4 Parts 1 Part		2-1/2	92.8	5.3
X B (3-3.9)	Diesel Oil	As Furnished		2	82.9	17.3
III B (2-2.5)	Diesel Oil + Pyridine	100 Parts 1 Part		2	84.5	15.4
III B (2.5-3.1)	Diesel Oil + Furfural	20 Parts 1 Part		2	77.6	3.5
III B (3.1-4)	Diesel Oil + Cresylic Acid	50 Parts 1 Part		2	84.0	5.0
III A (3-4)	Diesel Oil + Toluene	50 Parts 1 Part		2	90.5	16.7
II A (2-2.5)	Diesel Oil + Benzene	50 Parts 1 Part		2	88.5	11.0
II B (2.5-3)	Diesel Oil + Naphthalene	50 Parts 1 Part		2	84.0	0.0
II B (1-1.4)	X + Glycerine	4.12 Pounds .45 Pounds	11.0	2	40.0	No Record
II B (1.4-2)	X + Glycerine + Glue	4.12 Pounds .45 Pounds .04 Pounds	11.0	2	55.0	No Record

(1) Pitch Oil, a product of coal tar distillation secured from Koppers Company, Pittsburgh, Pennsylvania.
(2) Standard copper complex from lot made in Spokane by H. R. Offord.
(3) Contains in each gallon water 62 grams sodium acetate and 393.5 c.c. HCl (350 c.c. commercial HCl diluted to 1000 c.c.
(4) Contains in each gallon water 62 grams sodium acetate and 46 c.c. HCl (350 c.c. commercial HCl diluted to 1000 c.c.)
(5) Contains sodium acetate plus sodium hydroxide to pH 9.
(6) Standard Diesel Oil usually sold as fuel oil. Procured from Standard Oil Company, Spokane, Washington.
* Ribes lacustre.
Oil sprays applied to R. inerme and R. lacustre. Buffered sodium chlorate sprays applied to R. petiolare
Buffered Atlacide sprays applied to R. inerme.

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TABLE NO. 2

RESULTS OF 1930 EXPERIMENTAL CROWN AND STEM TREATMENTS AT SANTA, IDAHO
DATA TAKEN 1931

Experiment Number	Method of Treatment (See Legend)	Chemical Used	Number Crowns or Stems Treated	Feet of Live Stem Bush Number			Feet of Dead Stem Bush Number		
				1	2	3	1	2	3
1	Number 1	X*	3	1/4	0	2-1/2	10	50	50
2	Number 2	X	3	1/2	0	0	100	15	15
3	Number 3	X	3	0	5	0	N.R.	75	25
4	Number 4	X	3	2-1/2	0	3	N.R.	N.R.	N.R.
5	Number 1	Pitch Oil	3	60%	60%	6	40%	40%	7
6	Number 2	Pitch Oil	3	0	0	0	10	3	2
7	Number 3	Pitch Oil	3	0	0	N.R.	7	20	N.R.
8	Number 4	Pitch Oil	3	0	0	0	N.R.	N.R.	N.R.
9	Number 5	Pitch Oil	3	1	1	0	25	20	150
10	Number 1	Bismuth subbenzoate	3	10	10	N.R.	35	15	N.R.
11	Number 2	Bismuth subbenzoate	3	75	10	6	20	5	2
12	Number 3	Bismuth subbenzoate	3	75	25	N.R.	10	20	N.R.
13	Number 4	Bismuth subbenzoate	3	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
14	Number 1	Arsenic oxide	3	0	0	N.R.	75	20	N.R.
15	Number 2	Arsenic oxide	3	2	0	4	20	20	20
16	Number 3	Arsenic oxide	3	0	0	N.R.	16	50	N.R.
17	Number 4	Arsenic oxide	3	300	N.R.	N.R.	10	N.R.	N.R.
18	Number 1	Cadmium sulphate	3	N.R.	2-1/2	20	N.R.	25	20
19	Number 2	Cadmium sulphate	3	0	0	N.R.	3	40	N.R.
20	Number 3	Cadmium sulphate	3	0	0	0	30	4	15
21	Number 4	Cadmium sulphate	3	0	0	2	Small bushes		
22	Number 1	Cadmium chloride	3	0	0	N.R.	4	4	N.R.
23	Number 2	Cadmium chloride	3	50	1	3	12	25	30
24	Number 3	Cadmium chloride	3	0	1	2	40	25	75
25	Number 4	Cadmium chloride	3	1	N.R.	N.R.	N.R.	N.R.	N.R.
26	Number 6	Soluble copper cyanide	3	0	0	0	Medium bushes		
101	Number 6	Soluble copper cyanide	2	0	1/6		2	50	
27	Number 1	Fluorescein	2	75	N.R.		N.R.	N.R.	
28	Number 2	Fluorescein	2	N.R.	N.R.		N.R.	N.R.	
29	Number 3	Fluorescein	2	75	40		5	7	
30	Number 4	Fluroescein	2	1/2	3		N.R.	N.R.	
31	Number 1	Silver nitrate	2	0	0		5	4	
32	Number 2	Silver nitrate	2	0	25		25	25	
33	Number 3	Silver nitrate	2	0	N.R.		N.R.	N.R.	
IV A (1-1.3)	Number 6	X - 25%	25		132			466	
IV A (1.3-1.6)	Number 6	A** - 25%	12		219			85	
II A (2-3)	Number 7	X + Eosine	20 - 30		23			113	
34	Number 7	X + Eosine	4		4			55	

*Copper Complex
**Sodium chlorate

Method Number 1 - Portion of bark over crown scraped off with knife and chemical applied to wound as aqueous paste.

Method Number 2 - Crown notched into xylem and chemical applied to wound as aqueous paste.

Method Number 3 - Crown scratched with pruning saw and chemical applied as aqueous paste.

Method Number 4 - Stems cut off several inches above ground and thin aqueous paste applied to ends of cut-off stems.

Method Number 5 - Chemical applied in aqueous solution (or oil) about crown. No scarification of crown or stems.

Method Number 6 - One or more holes drilled into crown below stem tissue with Yankee twist drill. Chemical injected into these holes in aqueous solution by means of a modified Zerk grease gun.

Method Number 7 - One or more stems slit with knife near crown and chemical in form of thick aqueous paste packed into the slit stem.

N.R. - No record.

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TABLE NO. 3

RESULTS OF 1930 EXPERIMENTAL SPRAYING AND CROWN DRENCHING AT CLARKIA, IDAHO. DATA TAKEN IN 1931

Plot No.	Chemical Used	Concentration of Chemical in Pounds Per Gallon or in Parts by Volume	pH of Spray	Method of Application	Gallons of Solution Used	Pounds of Chemical Used	Area Covered	Ribes petiolare: Feet of Stem 1931 Surviving	Ribes petiolare: Feet of Stem 1931 New	Ribes petiolare: Feet of Stem 1931 Dead	Ribes petiolare: Per Cent Live Stem Killed	Ribes petiolare: Per Cent of Bushes Killed	Ribes inerme: Feet of Stem 1931 Surviving	Ribes inerme: Feet of Stem 1931 New	Ribes inerme: Feet of Stem 1931 Dead	Ribes inerme: Per Cent Live Stem Killed	Ribes inerme: Per Cent of Bushes Killed	Ribes lacustre: Feet of Stem 1931 Surviving	Ribes lacustre: Feet of Stem 1931 New	Ribes lacustre: Feet of Stem 1931 Dead	Ribes lacustre: Per Cent Live Stem Killed	Ribes lacustre: Per Cent of Bushes Killed
100	X*	2.06	6.5	Spray	27.0	55.6	1/2 Acre				10.0	0.0									2.0	0
101	X	3.13	6.5	Spray	19.5	61.0	1/2 Acre				15.0	1.0									3.0	0
102	X	2.06		Spray	26.0	53.6	1/2 Acre				8.0	0.0									2.0	0
103	X	3.13		Spray	35.5	111.2	1/2 Acre				15.0	2.0									3.0	0
104	X	2.06	6.5	Spray	42.0	86.6	1/2 Acre				5.0	0.0									0.0	0
105	X	3.13	6.5	Spray	25.0	74.5	1/2 Acre				15.0	1.0									0.0	0
106	X	2.06		Spray	29.0	59.8	1/2 Acre				5.0	0.0									0.0	0
109	$NaClO_3$ Atlacide	2.00 2.50		Crown Drench	278.0	556.0	1/2 Acre	13	0	360	96.6	71.4	1,900	117	9,800	87.3	37.2					
110	$ZnNH_4Cl_3$	2.00		Crown Drench	370.0	740.0	1/2 Acre						1,964	360	22,280	81.0	43.5	18	11	53	74.0	0
111	X	2.00		Crown Drench	100.0	200.0	1/6 Acre	0	0	90	100.0	100.0	934	119	6,780	88.8	69.5					
112	NaCl	2.00		Crown Drench	645.0	1,290.0	1/12 Acre	Very poor results - no check performed														
116	Pitch Oil	100%		Spray	16.0		1/2 Acre	386	407	2,414	86.2	0.0	5,045	2,300	9,350	65.1	0.6	10	25	200	95.3	0
117	Diesel Oil	100%		Spray	36.0		1/2 Acre	315	720	4,860	61.0	6.6	1,983	2,880	18,714	90.4	0.0					
118	Pitch Oil 1 Part Diesel Oil 1 Part			Spray	13.0		1/8 Acre	200	300	600	75.0	0.0	1,090	785	5,160	82.8	0.0					
119	Pitch Oil 1 Part Diesel Oil 4 Parts			Spray	19.0		1/4 Acre						5,360	375	5,360	48.6	0.0					

*Copper Complex
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TABLE NO. 4

RESULTS OF 1930 EXPERIMENTAL TREATMENTS IN STANISLAUS NATIONAL FOREST, CALIFORNIA. DATA TAKEN IN 1931

Plot Number	Chemical Used	Concentration in Pounds per Gallon or Per Cent by Volume	pH of Spray	Method of Treatment	R. roezli				R. nevadense			
					Total Number Bushes 1931	Per Cent Bushes Dead 1931	Total Feet Stem 1931	Per Cent Stem Dead 1931	Total Number Bushes 1931	Per Cent Bushes Dead 1931	Total Feet Stem 1931	Per Cent Stem Dead 1931
P.O.Area II	Diesel Oil	100%		Sprayed on leaves.	13	100.00	58.0	100.00				
#6 Area V	A*	2.0#		Injection after topping.	6	100.00						
#7 Area V	Diesel Oil	100%		Injection after topping.	5	100.00						
#10 Area IV	Diesel Oil + Pyridine	95% + 5%		Sprayed on leaves.	283	94.80	1,115.0	94.60				
#7 Area I	Atlacide	3.6#	3.6	Sprayed on leaves.	15	93.40	636.0	94.50				
#7 Area IV	Diesel Oil + Pitch Oil	75% + 25%		Sprayed on leaves.	108	92.70	614.0	91.50	1	100.0	10.0	100.0
#14 Area IV	A	1.4#	5.0	Sprayed on leaves.	73	91.75	2,067.0	99.50				
#8 Area IV	Diesel Oil + Pitch Oil	88% + 12%		Sprayed on leaves.	132	88.60	1,080.0	92.70	2	100.0	13.0	100.0
#6 Area IV	Diesel Oil + Pitch Oil	50% + 50%		Sprayed on leaves.	249	88.20	1,250.0	90.50	2	100.0	7.0	100.0
#1 Area II	Diesel Oil	100%		Sprayed on leaves.	23	87.00	1,321.0	99.40				
#4 Area II	Diesel Oil + Pitch Oil	75% + 25%		Applied to exposed crowns.	90	83.30	335.0					
P.O.Area II	Pitch Oil	100%		Sprayed on leaves.	49	81.75	520.0	64.75	82	68.5	675.0	95.3
#5 Area I	Atlacide	2.4#	5.0	Sprayed on leaves.	16	81.30	675.0	97.90	1	100.0	30.0	100.0
#11 Area IV	Diesel Oil + Napthalene + Toluol + Cresol + Phenol	88% + 5% + 5% + 1% + 1%		Sprayed on leaves.	264	80.10	1,450.0	90.60	12	83.4	46.0	22.8
#8 Area I	Atlacide	2.4#	4.5	Sprayed on leaves.	20	80.00	453.0	98.80				
#4 Area IV	De Ong Oil	10%		Sprayed on leaves.	29	79.50	268.0	92.00				
#2 Area II	Diesel Oil	100%		Applied to exposed crowns.	61	78.75	117.0					
#3 Area II	Diesel Oil	100%		Sprayed on lacerated tops.	56	78.70	118.5					
#12 Area IV	Diesel Oil + Furfural	95% + 5%		Sprayed on leaves.	70	78.60	956.0	93.90	3	100.0	16.0	100.0
#1 Area IV	Pearl Oil SO_2 Extract	100%		Sprayed on leaves.	115	76.50	1,038.0	86.50	3	0.0	18.0	14.3
#5 Area III	Diesel Oil	100%		Sprayed on leaves.	460	76.40	2,377.0	95.80	9	100.0	161.0	100.0
#7 Area III	Diesel Oil	100%		Applied to crowns.	72	75.00	1,075.0	85.10				
#3 Area IV	De Ong Oil	15%		Sprayed on leaves.	24	71.00	442.0	58.00	5	40.0	13.5	74.1
#14 Area I	Atlacide	2.4#	4.0	Sprayed on leaves.	23	69.60	347.0	92.50				
#6 Area III	Diesel Oil	100%		Applied to crowns.	186	68.90	3,588.0	87.10	12	8.3	34.5	45.7
#9 Area IV	Diesel Oil + Phenol + Cresol	98% + 1% + 1%		Sprayed on leaves.	93	61.40	1,901.0	95.20	2	50.0	63.0	81.0
#4 Area III	Diesel Oil + Kerosene	50% + 50%		Sprayed on leaves.	83	60.30	1,033.0	88.75	1	100.0	4.0	100.0
#4 Area V	X**	2.0#		Injection.	5	60.00		90.00				
#16 Area I	Pitch Oil + Phenol	98% + 2%		Sprayed on leaves.	46	58.70	964.0	77.80				
#16 Area IV	A	1.4#	4.0	Sprayed on leaves.	138	57.20	1,837.0	90.25	1	100.0	5.0	100.0
#15 Area I	Atlacide	2.4#	4.0	Sprayed on leaves.	36	55.70	869.0	91.50	2	50.0	15.5	96.6
#3 Area III	Kerosene	100%		Sprayed on leaves.	75	54.70	518.0	79.50	10	60.0	94.0	80.9
#19 Area IV	A	1.4#	4.5	Sprayed on leaves.	52	50.00	1,414.0	93.50				
#31 Area I	Atlacide	2.4#	No buffer	Sprayed on leaves.	33	48.50	882.0	79.20				
#17 Area IV	X	3.6#	6.5	Sprayed on leaves.	81	48.20	575.0	71.50	1	100.0	3.0	100.0
#9 Area I	A	1.4#	3.5	Sprayed on leaves.	26	46.20	700.0	70.00	4	75.0	102.0	98.0
#27 Area I	A	1.4#	No buffer	Sprayed on leaves.	8	37.60	1,096.0	48.70				
#3 Area I	Atlacide	1.4#	4.0	Sprayed on leaves	16	31.30	1,108.0	63.50				
#32 Area I	Pitch Oil + Napthalene	95% + 5%		Sprayed on leaves.	36	30.60	1,205.0	67.60				
#22 Area I	Pitch Oil + Pyridine	95% + 5%		Sprayed on leaves.	23	30.50	746.0	66.30	30	26.6	921.0	66.1
#1 Area I	Atlacide	1.4#	5.0	Sprayed on leaves.	37	29.70	1,236.0	53.00				
#13 Area I	A	.89#	3.6	Sprayed on leaves.	34	29.40	1,183.0	40.30	2	0.0	13.0	69.2
#2 Area III	Gasoline	100%		Applied to crowns.	97	26.80	1,321.0	56.00	5	80.0	64.0	64.3
#19 Area I	Atlacide	2.4#	4.0	Sprayed on leaves.	16	25.00	377.0	74.00				
#24 Area I	Pitch Oil + Furfural	95% + 5%		Sprayed on leaves.	32	25.00	1,231.0	58.80	14	21.4	498.0	55.1
#30 Area I	Atlacide	1.4#	No buffer	Sprayed on leaves.	24	25.00	768.0	57.60				
#4 Area I	Atlacide	1.4#	4.5	Sprayed on leaves.	36	22.20	1,553.0	49.50	13	61.5	392.0	96.5
#26 Area I	A	.89#	No buffer	Sprayed on leaves.	18	22.20	1,040.0	37.00				
#2 Area I	Atlacide	1.4#	3.6	Sprayed on leaves.	28	21.40	712.0	64.60				
#2 Area IV	Mineral Seal Oil SO_2 Extract	100%		Sprayed on leaves.	108	21.30	932.0	80.80	4	100.0	39.0	100.0
#1 Area V	A	2.0#		Injection.	5	20.00		50.00				
#2 Area V	Sodium Copper Cyanide	2.0#		Injection.	10	20.00		50.00				
#8 Area V	Diesel Oil	100%		Injection.	5	20.00		25.00				
#25 Area I	Pitch Oil + Benzol	98% + 2%		Sprayed on leaves.	52	19.20	617.0	65.20	44	9.1	713.0	57.8
#11 Area I	A	.89#	4.5	Sprayed on leaves.	18	16.70	786.0	52.40	6	16.7	300.0	57.6
#10 Area IV	A	.89#	5.0	Sprayed on leaves.	20	15.00	768.0	54.60	4	50.0	136.0	88.4
#5 Area IV	Diesel Oil	100%		Sprayed on leaves.		10.00		50.00	Numerous R. roezli 1 foot high. Dense shade white fir and aspen. Heavy overlay compact sediment. Much layering.			
#23 Area I	Pitch Oil + Cresol	98% + 2%		Sprayed on leaves.	31	9.70	1,173.0	48.60	15	26.7	375.0	58.9
#1 Area III	Gasoline	100%		Sprayed on leaves.	50	8.30	1,143.0	40.40	1	0.0	1.0	50.0
#12 Area I	A	.89#	4.0	Sprayed on leaves.	17	5.90	677.0	48.00	2	0.0	75.0	60.0
#6 Area I	Pitch Oil + Toluol	95% + 5%		Sprayed on leaves.		5.00		25.00				
#16 Area IV	X	3.6#	11.0	Sprayed on leaves.		3.00		15.00				
#29 Area I	Atlacide	.67#	No buffer	Sprayed on leaves.		1.00		20.00				
#13 Area IV	X	2.7#	11.0	Sprayed on leaves.		0.00		35.00				
#15 Area IV	X	2.7#	6.5	Sprayed on leaves.		0.00		15.00				
#28 Area I	A	.44#	No buffer	Sprayed on leaves.		0.00		5.00				
#17 Area I	A	.44#	4.5	Sprayed on leaves.		0.00		5.00		0.0		0.0
#18 Area I	A	.44#	5.0	Sprayed on leaves.		0.00		5.00		0.0		0.0
#21 Area I	A	.44#	5.0	Sprayed on leaves.		0.00		5.00		0.0		0.0
#20 Area I	A	.44#	4.0	Sprayed on leaves.		0.00		3.00				
#5 Area V	Potassium Chromium Thiocyanate	2.0#		Injection.	6	0.00		15.00				
#3 Area V	Chloral hydrate	2.0#		Injection.	6	0.00		0.00				

*Sodium chlorate. **Copper complex.

Area I - Section 10, R. 18 E., T. 4 N., laid out and treated by R. P. d'Urbal.
Area II - Section 10, R. 18 E., T. 4 N., laid out and treated by W. V. Benedict.
Area III - Section 2, R. 18 E., T. 4 N., laid out and treated by W. V. Benedict.
Area IV - Section 2, R. 18 E., T. 4 N., laid out and treated by R. P. d'Urbal.
Area V - Section 2, R. 18 E., T. 4 N., laid out and treated by G. R. Van Atta

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Of all the treatments of this general type that were tried, those in which oils were used showed the most promise, and sodium chloride gave the poorest results. It would be quite unsafe, however, to use these preliminary indications as the basis for a final evaluation of the materials that were used, since very little was known concerning the best way in which such applications should be made. It is fairly evident, however, that those treatments in which aerial parts of the plants were cut away before the chemical was applied were peculiarly successful. It is difficult to see how this observation can become of very great practical importance, since the removal of aerial parts is frequently the equivalent of hand eradication in terms of the operating time involved.

Idaho spray experiments: Figures given in Tables No's. 1, 2, and 3 bring to light the following points:

1. The use of oil sprays produced erratic results. Some fairly high R. inerme live-stem kills were obtained, but in all instances where oils were used failure to kill a satisfactory percentage of the bushes treated was experienced. These facts are somewhat at variance with the results of Diesel oil applications made to R. roezli in California.

2. The salts of cadmium and silver used at Santa, Idaho, were relatively ineffective when applied as aqueous sprays.

3. It is impossible to correlate the pH of chlorate sprays with their effectiveness by means of the results of the tests reported. This point is more fully discussed in connection with the California experiments.

4. Copper complex is quite definitely not a satisfactory ribicide when applied in the form of an aerial spray.

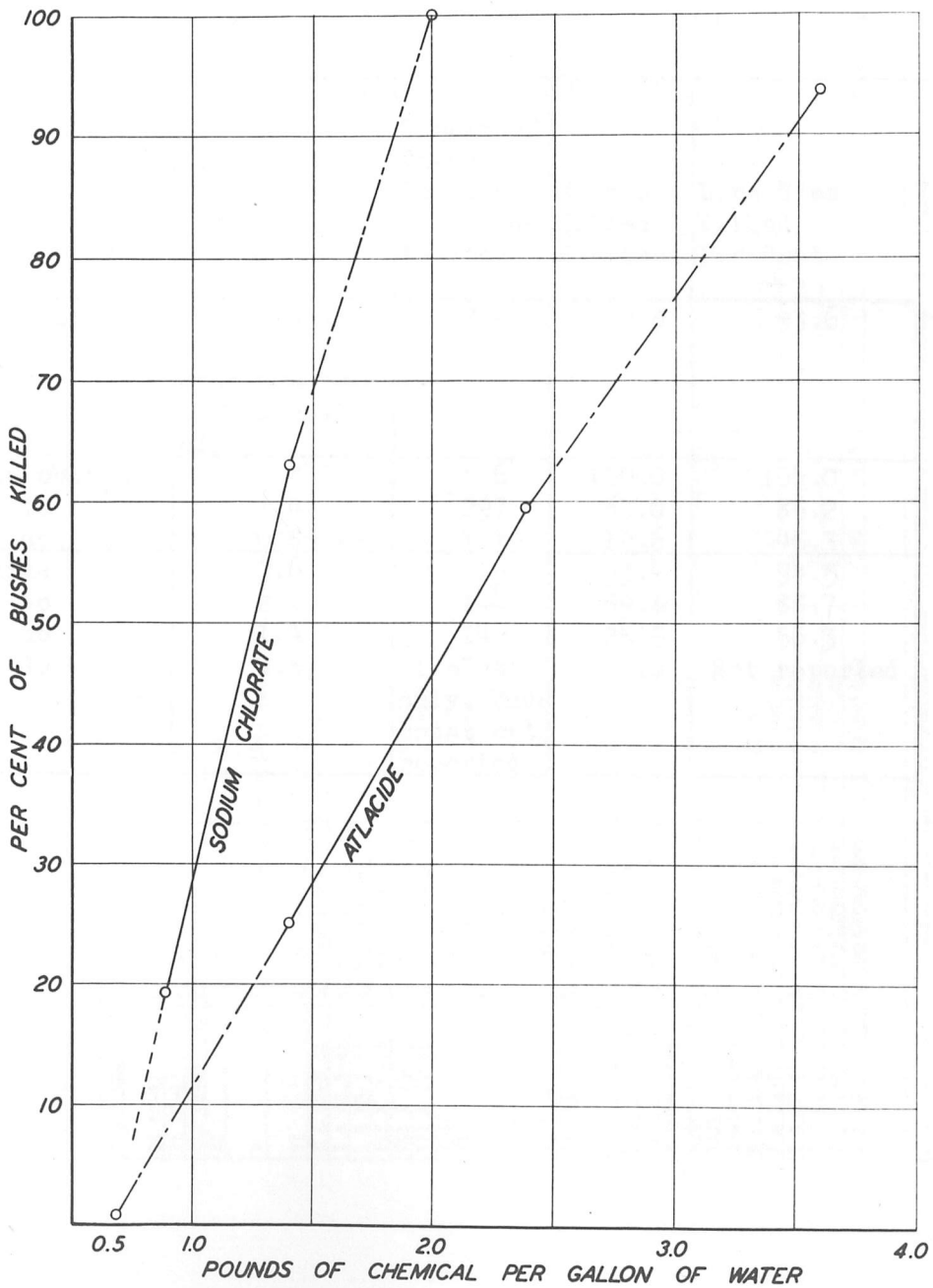
California spray experiments: A critical examination of the data presented in Table No. 4 discloses that it is impossible to ascertain the relative effectiveness of chlorate sprays of different pH values by means of field experiments of the type reported. This is an affirmation of results previously obtained, but in no way contradicts the findings of laboratory work which has repeatedly shown that very slightly acid aqueous solutions of chlorates are more toxic to the majority of plants than are solutions which are either somewhat more acid or more alkaline. The laboratory findings, while perfectly valid, are dependent upon conditions which cannot be maintained in experiments conducted in the field. Thus, for example, the magnitude of the difference in effects which would be produced by treating Ribes growing in the field with chlorate sprays of very slightly different acidities would be so small that it would be completely overshadowed by the effects of plant variability.

A very striking feature of the results given in Table No. 4 is the apparently high degree of effectiveness of Diesel oil as a ribicide when applied to R. roezli. Observations made in the field seem to indicate that oils aremost effective when they are applied both as a heavy drench to dry soil about the base of the plant and as a thorough spray on the aerial parts. Indications are that moist soil would greatly hinder the action of oils as ribicides. It is also possible to obtain from the data presented in Table No. 4 a very good comparison of the effectiveness of sodium chlorate and sodium chlorate-calcium chloride sprays in various concentrations. Table No. 5, which is derived from Table No. 4, illustrates these points.

Figure 1 depicts graphically the relative effectiveness shown by the chlorate sprays used in these experiments. The broken lines in the figure terminate in points at the ends of the curves, which points are representative of results obtained by treating a relatively small number of plants. The dotted line is an extrapolation of the sodium chlorate curve and is drawn to indicate the probable course of the curve below the limit found by these experiments. The two curves in Figure 1 clearly show that in fairly low concentration Atlacide is as effective pound for pound as sodium chlorate, but that as the concentration is increased sodium chlorate becomes much more toxic than an equal weight of Atlacide. These curves offer striking confirmation of what is known concerning the role that osmotic pressure and the antagonism between different ions in the same solution play in the action of such solutions upon living organisms. The theories involved also predict that in still lower concentrations than those here recorded, sodium chlorate should again become more toxic than Atlacide. This has been found to be true in greenhouse tests which were discussed in the summary of research work presented in this report. Were it not for these influences and the minor toxicity of chloride ion as such, Atlacide would always be approximately two-thirds as effective as sodium chlorate upon a weight basis.

FIGURE NO. 1

COMPARISON OF EFFECTIVENESS OF SODIUM CHLORATE AND ATLACIDE WHEN USED IN SPRAYS OF VARIOUS CONCENTRATIONS ON *RIBES ROEZLI*



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TABLE NO. 5

COMPARISION OF EFFECTIVENESS OF DIESEL OIL AND CHLORATE SPRAYS AS SHOWN BY RESULTS OBTAINED FROM 1930 EXPERIMENTS ON R. ROEZLI IN CALIFORNIA.

Chemical Used	Concentration of Chemical in Pounds Per Gallon	Number of Bushes Involved in Calculations	Bushes Killed Per Cent	Live Stem Killed Per Cent
Diesel oil	Pure and in mixtures of from 50% to 100% Diesel oil.	1,778	80.8	93.6
Sodium chlorate	2.0	6	100.0	100.0
do	1.4	297	63.0	85.2
do	0.89	107	19.6	45.3
Atlacide	3.6	15	93.4	94.5
do	2.4	144	59.3	88.7
do	1.4	141	25.5	56.3
do	0.67	1 plot only, bush count not reported	1.0	Not reported

TABLE NO. 6

RESULTS OF 1930 EXPERIMENTAL TREATMENTS IN OREGON. DATA TAKEN 1931

Plot Number	Ribes Species	Chemical Used	Concentration in Pounds Per Gallon H_2O	pH of Spray	Gallons of Spray Used	New Live Stem Per Cent (1931)	Live Stem Kill Per Cent	Bush Kill Per Cent
Still Creek I	R. bracteosum	A*	0.89	4.0	5	15.0	80.0	0.0
II (0-1)	R. bracteosum	A + Calcium chloride	2.70 2.70	7.0	5	5.0	100.0	40.0
II (0-1)	R. lacustre	Atlacide	3.60	3.5	5	1.0	100.0	50.0
III (1-2)	R. lacustre	A	0.89	4.0	5	2.5	95.0	15.0
IV	R. lacustre	Atlacide	3.60	9.0	5	2.0	95.0	0.0
V	R. bracteosum	A + Sodium chloride	0.89 2.08	3.5	5	10.0	100.0	25.0
VI	R. bracteosum	A + Sodium chloride	0.44 2.70	3.5	5	2.5	98.0	25.0
I A (3-3.5)	R. bracteosum	A	2.08	4.0	5	2.0	100.0	0.0
I A (3.5-4)	R. bracteosum	A	1.40	4.0	5	5.0	100.0	0.0
I B (3-3.5)	R. bracteosum	A	2.08	3.5	5	3.0	100.0	10.0
VII A (0-1)	R. bracteosum	A	0.89	4.0	5	33.0	90.0	0.0
VII A (1-2)	R. bracteosum	Atlacide	3.60	3.5	5	1.0	100.0	33.0
VII A (2-3)	R. bracteosum	Atlacide	3.60	9.0	5	3.3	100.0	50.0
VIII	R. lacustre	A	2.08	7.0	5	1.0	99.5	50.0
IX	R. lacustre	A	0.89	5.0	5	3.0	100.0	No Record
X	R. bracteosum R. lacustre	Diesel Oil	100%		10	60.0 30.0	100.0 100.0	0.0 0.0
XI (1-2)	R. lacustre	A + Calcium chloride	2.70 2.70		5	5.5	100.0	10.0
XII (1-2)	R. lacustre	A	0.89	4.0	5	2.0	100.0	5.0
XIII	R. bracteosum	Diesel Oil + Furfural	95% 5%		10	50.0	95.0	0.0
Loop Highway I	R. watsonianum	A	2.08	3.5	5	20.0	75.0	25.0
II	R. watsonianum	A	2.08	7.0	5	20.0	75.0	25.0
Huckleberry Mountain VII	R. lobbii	Atlacide	3.60	7.0	5	5.0	96.0	20.0
VIII	R. lobbii	Atlacide	3.60	4.0	5	20.0	56.0	17.0
Crater Lake N.P. I A (0-1)	R. erythrocarpum	Atlacide	1.40	6.5		0.0	100.0	99.2
I A (1-2)	R. erythrocarpum	Atlacide	1.40	4.5		0.0	100.0	100.0
I A (2-3)	R. erythrocarpum	Atlacide	3.60	6.5		0.0	100.0	100.0
I B (0-1)	R. erythrocarpum	Atlacide	0.67	6.5		1.0	100.0	60.0
I B (1-2)	R. erythrocarpum	Atlacide	0.67	4.5		0.1	100.0	75.0
I B (2-3)	R. erythrocarpum	Atlacide	3.60	4.5		0.0	100.0	100.0

Crown and Stem Treatment on R. lobbii, Loop Highway					
Experiment Number	Chemical Used	Method of Treatment	Number Bushes	Live Stem Kill Per Cent	Bush Kill Per Cent
I	X aqueous paste**	Crowns lacerated; paste applied to surfaces.	3	100.0	100.0
II	X aqueous paste**	Crowns notched; notch filled with paste.	3	100.0	100.0

*Sodium chlorate
**Copper complex

Oregon spray experiments: Chlorate sprays in all instances failed to effect a satisfactory proportion of R. bracteosum bush kill, although fair live-stem kills were nearly always obtained. The chances for successfully reworking many of the checked plots by some other method than was first employed would be very poor, were such a move contemplated. This is true largely because a heavy brush cover survives selective spraying in these areas. Indications are that many of the sprays tried on R. bracteosum are quite toxic to the plant but that present methods of application are at fault. Sustained contact between the chemical and many plant parts is apparently essential to successful kill. Present methods of treatment do not appear to offer such contact. This statement, while made with particular reference to R. bracteosum, seems to apply with equal force to many of the other Ribes species.

R. lacustre in Oregon seems to respond somewhat better to chlorate sprays than does R. bracteosum, but here again spraying with chlorates did not produce satisfactory kills. The R. lacustre plots examined did, however, appear to offer better chances for reworking than did the R. bracteosum areas.

Diesel oil was used on only one R. bracteosum plot, and the results obtained in this instance indicated that it is practically worthless for use on this species. It is probable that the moist habitat of R. bracteosum is in part responsible for the failure to achieve a high percentage of kill through the application of oil.

Fifteen and 30 per cent Atlacide sprays gave very good results when applied to R. erythrocarpum. Seven and one-half per cent solutions of Atlacide gave complete live-stem kill but failed to kill all the bushes.

B. Recheck of Experimental Plots First Laid Out and Treated at Clarkia, Idaho, in 1929 and Discussion of Results.

In 1929 an extensive field program was undertaken at Clarkia, Idaho. One hundred and forty one-half-acre plots were treated with experimental sprays. These plots were checked in 1930. Besides being checked, certain of the plots were divided into two equal portions of one-quarter acre each. One of each of these pairs of small plots was then resprayed with a solution of the same composition as was used the previous year on the whole plot. The application was made on or about the same day of the year as the 1929 application. Nothing further was done in 1930 to the remaining member of each pair of the one-quarter-acre plots.

The purpose of continuing the program that was begun in 1929 has been to study the rate at which Ribes population may be decreased by the use of chemical sprays when they are applied only once and when they are applied more than once at intervals of a year or more. This study also necessarily involves the rate at which regeneration takes place when Ribes plants have been damaged but not killed by chemicals.

For convenience, those half plots that were first sprayed 1929 and again in 1930 will be referred to as the "A" group, those t. were sprayed in 1929 and not treated with chemicals in 1930 will be ca. the "B" group. Tables No's. 7, 8, and 9 present a summary of the data taken to date from the "A" group of half plots. Tables No's. 10, 11, and 12 give a similar summary covering the "B" group. Some of the figures in the tables appeared in the 1930 annual report and are repeated here to facilitate study of the experiment as a whole.

The usual practice when studying the effectiveness of a chemical as a ribidice is to base calculations upon the percentage of live stem killed by the chemical. Where it is possible to obtain the necessary information with accuracy, the percentage of bushes killed is sometimes used in preference to the figure representing live stem killed.

Another method of evaluation and one which is admirably suited to present needs is based on the expression of the results of treatment in terms of the percentage of live-stem reduction accomplished by spraying. It will be noted that in calculating the percentage of live-stem reduction, account is taken of the new growth that has appeared since chemicals were applied. Some figures for bush kill are available and are also given in the tables.

Mention should be made of the variable nature of the results as reported in the tables. A discussion of the occurrence and causes for variability in the results obtained from these experiments was given in the annual report for 1930. It will be unnecessary to repeat the discussion of causes, but attention is called to the fact that the weighted percentages of R. petiolare live-stem reduction for the period from 1929 to 1930 as given in the tables for the half plots have been found to vary as much as 7 per cent of the recorded values from the corresponding figures for the whole plot. It has also been found that the weighted percentages reported for Atlacide 15 per cent and for sodium chlorate 10 per cent plus calcium chloride 5 per cent varied as much as 16 per cent from the true mean. The compositions of these two sprays were as chemically identical to each other as field practice could make them and consequently some factor other than composition caused the large variation in effects observed. Different sets of plots are involved rather than opposite halves of common plots and large differences in environment are probably responsible in part at least for the discrepancy in the results. The exact nature of the cause is not as important as is the fact that if the same variation existed elsewhere it could not be as readily detected as it was in this instance, and consequently failure to note its existence might easily lead to the inference of false deductions.

TABLE NO. 7

RESULTS PRODUCED BY EXPERIMENTAL SPRAYS APPLIED TO R. PETIOLARE AT CLARKIA, IDAHO
DATA TAKEN 1931 FROM PLOTS SPRAYED IN 1929 AND 1930

Spray Formula	Plot Number "A" Half	Feet of Live Stem Before Spraying 1929	Feet of Live Stem 1930			Percentage of Live Stem Reduction 1929-1930	Feet of Live Stem 1931			Percentage of Live Stem Reduction 1929-1931	Per Cent Bush Kill 1929 to 1931	Date of Spray Application	
			Surviving	New	Total		Surviving	New	Total			1929	1930
$NaClO_3$ - 5% .45# per Gallon pH 6.5 Glue	23(1)	454	36	86	122	73.1	28	21	49	89.2	55.5	July 11	July 12
	43(1)	320	3	27	30	90.7	1	2	3	99.1	80.0	July 26	July 26
	62(1)	3,774	1,251	219	1,470	61.1	14	40	54	98.6	83.8	August 8	August 11
	77(1)	10,572	1,432	486	1,918	82.0	313	207	520	95.1	47.1	August 23	August 23
Totals and Weighted Percentages		15,120			3,440	77.2			626	95.9			
$NaClO_3$ - 10% .89# per Gallon pH 6.5 Glue	*1	No Record					**15	**20	**35		0.0	June 17	June 17
	23	5,220	34	62	96	98.1	33	34	67	98.9	79.3	July 11	July 12
	43	16,512	75	76	151	99.1	17	2	19	99.9	94.7	July 26	July 26
	62	2,446	4	27	31	98.7	35	24	59	97.6	87.5	August 8	August 11
	*77	10,213	1,749	443	2,192	78.5	33	128	161	98.5	60.7	August 23	August 23
Totals and Weighted Percentages		34,391			2,470	92.8			306	99.1			
Atlacide - 7.5% .68# per Gallon pH 6.5 Glue	44	9,122	233	212	445	95.1	34	18	52	99.3	75.8	July 26	July 26
	63	1,513	253	150	403	73.4	770	1,120	1,890	# 24.9	38.3	August 9	August 11
	78	13,730	°5,355		5,355	61.0	383	437	820	94.0	24.3	August 23	August 25
Totals and Weighted Percentages		24,365			6,203	74.5			2,762	88.7			
$NaClO_3$ - 5% .45# per Gallon $CaCl_2$ 2.5% .23# per Gallon pH 6.5 Glue	25(1)	4,277	239	199	438	89.8	19	15	34	96.7	45.5	July 12	July 14
	45(1)	9,841	346	301	647	93.4	90	28	118	98.8	84.0	July 27	July 28
	64(1)	21,104	4,165	1,335	5,500	73.9	200	431	631	97.0	42.8	August 9	August 12
	*79(1)	6,482	°3,954		3,954	39.0	344	268	612	90.5	No Record	August 24	August 26
Totals and Weighted Percentages		41,704			10,539	74.7			1,395	96.7			
Atlacide - 15% 1.36# per Gallon pH 6.5 Glue	46	2,405	57	74	121	94.9	67	3	70	97.1	83.8	July 27	July 28
	65	919	57	53	110	88.0	8	4	12	98.7	82.3	August 10	August 12
	*80	7,731	°2,706		2,706	65.0	169	234	403	94.8	No Record	August 24	August 27
Totals and Weighted Percentages		11,055			2,937	73.4			485	97.7			
$NaClO_3$ - 10% .89# per Gallon $CaCl_2$ 5% .47# per Gallon pH 6.5 Glue	3	No Record					**100	**23	**123		75.0	June 17	June 17
	25	2,179	152	90	242	88.4	25	18	43	98.0	57.2	July 13	July 12
	45	11,111	123	229	352	96.8	39	33	72	99.7	97.2	July 27	July 28
	64	3,649	234	129	363	92.6	97	55	152	98.0	68.1	August 9	August 12
	79	2,200	°880		880	60.0	163	149	312	85.9	No Record	August 24	August 27
Totals and Weighted Percentages		19,139			1,837	90.4			579	97.0			
$NaClO_3$ - 30% 2.7# per Gallon $CaCl_2$ 15% 1.4# per Gallon pH 6.5 Glue	4	No Record					**0	**0		**100.0	100.0	June 17	June 17
	26	742	27	19	46	93.9	°8		8	98.8	0.0	July 15	July 14

*North half plots; all others are west half plots.
**Figures excluded from calculations of totals and percentages because complete records for the three years were not available.
#Increase.
°Figures represent surviving and new stem combined.

TABLE NO. 8

RESULTS PRODUCED BY EXPERIMENTAL SPRAYS APPLIED TO R. INERME AT CLARKIA, IDAHO
DATA TAKEN 1931 FROM PLOTS SPRAYED IN 1929 AND 1930.

Spray Formula	Plot Number "A" Half	Feet of Live Stem Before Spraying 1929	Feet of Live Stem 1930			Percentage of Live Stem Reduction 1929-1930	Feet of Live Stem 1931			Percentage of Live Stem Reduction 1929-1931	Per Cent Bush Kill 1929-1931	Date of Spray Application	
			Surviving	New	Total		Surviving	New	Total			1929	1930
	23(1)	8,232	3,110	1,906	5,016	39.1	1,264	903	2,167	73.7	10.0	July 11	July 12
$NaClO_3$ - 5%	43(1)	189	27	20	47	69.9	0	0	0	100.0	100.0	July 26	July 26
.45# per Gallon	62(1)	0	0	0	0		0	0	0			August 8	August 11
pH 6.5 Glue	77(1)	0	0	0	0		0	0	0			August 23	August 23
Totals and Weighted Percentages		8,421			5,063	39.9			2,167	74.3			
	*1	No Record					**106	**33	**139		28.6	June 17	June 17
$NaClO_3$ - 10%	23	2,181	248	209	467	79.0	97	186	283	87.1	37.7	July 11	July 12
.89# per Gallon	43	1,323	169	104	273	79.5	36	52	88	93.3	50.0	July 26	July 26
pH 6.5	62	0	0	0	0		0	0	0			August 8	August 11
Glue	*77	0	0	0	0		0	0	0			August 23	August 23
Totals and Weighted Percentages		3,504			730	79.2			371	89.4			
Atlacide - 7.5%	44	2,381	1,043	310	1,353	43.1	448	484	932	60.8	9.5	July 26	July 26
.68# per Gallon	63	0	0	0	0		**21	**25	**46	-	0.0	August 9	August 11
pH 6.5 Glue	78		**25		**25		**97	0	**97		66.0	August 23	August 25
Totals and Weighted Percentages		2,381			1,353	43.1			932	60.8			
	25(1)	4,879	1,269	1,009	2,278	53.3	1,027	398	1,425	70.8	18.2	July 12	July 14
$NaClO_3$ - 5% .45#	45(1)	461	156	44	200	56.6	7	5	12	97.5	0.0	July 27	July 28
per Gallon $CaCl_2$	64(1)	0	0	0	0		0	0	0			August 9	August 12
2.5% .23# per Gallon pH 6.5 Glue	*79(1)	507	°421		421	17.0	713	258	971	#91.6	0.0	August 24	August 26
Totals and Weighted Percentages		5,847			2,899	50.6			2,408	58.8			
Atlacide - 15%	46	1,202	861	174	1,035	13.9	216	244	460	60.8	3.33	July 27	July 28
1.36# per Gallon	65	0	0	0	0		0	0	0			August 10	August 12
pH 6.5 Glue	*80	2,597	°2,078		2,078	20.0	1,516	431	1,947	25.0	0.0	August 24	August 27
Totals and Weighted Percentages		3,799			3,113	18.1			2,407	36.6			
$NaClO_3$ - 10% .89#	3	No Record					**260	**145	**405		24.2	June 17	June 17
per Gallon $CaCl_2$	25	6,159	4,100	2,309	6,409	#4.1	1,436	346	1,782	71.2	16.1	July 13	July 12
5% .47# per Gallon	45	72	37	39	76	#5.6	10	33	43	40.3	0.0	July 27	July 28
pH 6.5	64	0	0	0	0		0	0	0		0.0	August 9	August 12
Glue	79	655	°465		465	29.0	1,169	368	1,537	#134.6	0.0	August 24	August 27
Totals and Weighted Percentages		6,886			6,950	#1.1			3,362	51.1			
$NaClO_3$ - 30% 2.7#	4	No Record					**470	**770	**1,249		27.0	June 17	June 17
per Gallon $CaCl_2$	26	8,815	1,773	1,462	3,235	63.4	649	482	1,131	87.1	40.0	July 15	July 14
15% 1.4# per Gallon pH 6.5 Glue													

* North half plots; all others are west half plots.
** Figures excluded from calculations of totals and percentages because complete records for the three years were not available.
Increase.
° Figures represent surviving and new stem combined.

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TABLE NO. 9

RESULTS PRODUCED BY EXPERIMENTAL SPRAYS APPLIED TO R. LACUSTRE AT CLARKIA, IDAHO
DATA TAKEN 1931 FROM PLOTS SPRAYED IN 1929 AND 1930.

Spray Formula	Plot Number "A" Half	Feet of Live Stem Before Spraying 1929	Feet of Live Stem 1930			Percentage of Live Stem Reduction 1929-1930	Feet of Live Stem 1931			Percentage of Live Stem Reduction 1929-1931	Per Cent Bush Kill 1929-1931	Date of Spray Application	
			Surviving	New	Total		Surviving	New	Total			1929	1930
$NaClO_3$ - 5% .45# per Gallon pH 6.5 Glue	23(1)	61	42	34	76	#24.6	0	0	0	100.0	100.0	July 11	July 12
	43(1)	3,596	731	205	936	74.0	147	86	233	93.7	42.2	July 26	July 26
	62(1)	386	160	15	175	54.7	109	16	125	67.5	8.5	August 8	August 11
	77(1)	233	123	37	160	52.3	83	42	125	46.5	35.0	August 23	August 23
Totals and Weighted Percentages		4,276			1,347	68.5			483	88.7			
$NaClO_3$ - 10% .89# per Gallon pH 6.5 Glue	*1	0	0	0	0		0	0	0			June 17	June 17
	23	32	18	5	23	28.1	0	0	0	100.0	100.0	July 11	July 12
	43	3,809	223	104	327	91.4	27	38	65	98.4	2.5	July 26	July 26
	62	553	138	46	184	66.7	93	72	165	70.1	12.0	August 8	August 11
	*77	374	285	29	314	15.9	42	27	69	81.6	17.4	August 23	August 23
Totals and Weighted Percentages		4,768			848	82.2			299	93.7			
Atlacide - 7.5% .68# per Gallon pH 6.5 Glue	44	414	49	24	73	82.4	57	24	81	80.5	52.7	July 26	July 26
	63	2,553	1,310	132	1,442	43.4	236	117	353	87.0	9.1	August 9	August 11
	78	270	o203		203	24.8	10	0	10	96.3	0.0	August 23	August 25
Totals and Weighted Percentages		3,237			1,718	46.9			444	86.3			
$NaClO_3$ - 5% .45# per Gallon $CaCl_2$ 2.5% .23# per Gallon pH 6.5 Glue	25(1)	37	26	16	42	#13.5	0	0	0	100.0	100.0	July 12	July 14
	45(1)	765	301	50	351	54.1	227	79	306	60.0	6.9	July 27	July 28
	64(1)	181	122	29	151	16.5	141	66	207	#14.4	10.0	August 9	August 12
	*79(1)	212	o150		150	29.2	150	34	184	17.9	0.0	August 24	August 26
Totals and Weighted Percentages		1,195			694	42.0			697	41.7			
Atlacide - 15% 1.36# per Gallon pH 6.5 Glue	46	914	339	35	374	59.1	109	29	138	30.2	8.4	July 27	July 28
	65	590	196	46	242	58.9	23	15	38	76.6	48.2	August 10	August 12
	*80	203	o165		165	18.7	10	0	10	95.1	0.0	August 24	August 27
Totals and Weighted Percentages		1,707			781	53.2			186	89.1			
$NaClO_3$ - 10% .89# per Gallon $CaCl_2$ 5% .47# per Gallon pH 6.5 Glue	3	0	0	0	0		0	0	0			June 17	June 17
	25	58	31	6	37	36.2	3	0	3	94.8	0.0	July 13	July 12
	45	745	183	31	214	71.2	68	18	86	88.4	16.7	July 27	July 28
	64	388	85	42	127	67.3	42	19	61	84.3	20.0	August 9	August 12
	79	303	o224		224	26.0	60	10	70	77.0	0.0	August 24	August 27
Totals and Weighted Percentages		1,494			602	59.7			220	85.1			
$NaClO_3$ - 30% 2.7# per Gallon $CaCl_2$ 15% 1.4# per Gallon pH 6.5 Glue	4	0	0	0	0		0	0	0			June 17	June 17
	26	289	20	10	30	89.6	0	0	0	100.0	100.0	July 15	July 14

* North half plots; all others are west half plots.
\# Increase.
o Figures represent surviving and new stem combined.

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TABLE NO. 10

RESULTS PRODUCED BY EXPERIMENTAL SPRAYS APPLIED TO R. PETIOLARE AT CLARKIA, IDAHO
DATA TAKEN 1931 FROM PLOTS SPRAYED IN 1929.

Spray Formula	Plot Number "B" Half	Feet of Live Stem Before Spraying 1929	Feet of Live Stem 1930			Percentage of Live Stem Reduction 1929-1930	Feet of Live Stem 1931			Percentage of Live Stem Reduction 1929-1931	Date of Spray Application 1929
			Surviving	New	Total		Surviving	New	Total		
$NaClO_3$ - 5% .45# per Gallon pH 6.5 Glue	23(1)	12,010	2,993	734	3,727	68.5	903	578	1,481	87.7	July 11
	43(1)	4,163	83	94	177	95.7	107	183	290	93.0	July 26
	62(1)	3,256	93	52	145	95.5	183	174	357	89.0	August 8
	77(1)	4,980	o747		747	85.0	627	282	909	81.8	August 23
Totals and Weighted Percentages		24,409			4,796	80.4			3,037	87.6	
$NaClO_3$ - 10% .89# per Gallon pH 6.5 Glue	*1	No Record					**18	**39	**57		June 17
	23	8,293	1,514	508	2,022	75.4	1,208	547	1,755	78.8	July 11
	43	4,528	265	119	384	91.5	214	157	371	91.8	July 26
	62	2,806	122	66	188	93.3	66	58	124	95.6	August 8
	*77	1,358	o231		231	83.0	126	177	303	77.7	August 23
Totals and Weighted Percentages		16,895			2,825	83.2			2,553	84.9	
Atlacide - 7.5% .68# per Gallon pH 6.5 Glue	44	2,412	146	146	292	87.9	210	146	356	85.2	July 26
	63	10,615	923	559	1,482	86.0	410	559	969	90.9	August 9
	78	12,960	o5,057		5,057	61.0	3,804	2,847	6,651	48.6	August 23
Totals and Weighted Percentages		25,987			6,831	73.7			7,976	60.3	
$NaClO_3$ - 5% .45# per Gallon $CaCl_2$ 2.5% .23# per Gallon pH 6.5 Glue	25(1)	4,886	1,183	509	1,692	65.3	266	253	519	56.2	July 12
	45(1)	3,780	199	120	319	91.6	74	63	137	97.2	July 27
	64(1)	5,999	535	202	737	87.7	787	377	1,164	80.6	August 9
	*79(1)	4,890	o2,983		2,983	41.1	1,816	1,747	3,563	27.1	August 24
Totals and Weighted Percentages		19,555			5,731	70.7			5,383	72.4	
Atlacide - 15% 1.36# per Gallon pH 6.5 Glue	46	4,158	852	355	1,207	71.0	282	538	820	80.3	July 27
	65	6,400	148	54	202	96.9	129	105	134	97.9	August 10
	*80	2,590	o906		906	65.1	554	502	1,056	59.2	August 24
Totals and Weighted Percentages		13,148			2,315	82.4			2,110	84.0	
$NaClO_3$ - 10% .89# per Gallon $CaCl_2$ 5% .47# per Gallon pH 6.5 Glue	3	No Record					No Record				June 17
	25	1,835	60	30	90	95.1	12	22	34	98.1	July 13
	45	15,918	252	160	412	97.4	175	155	330	97.9	July 27
	64	9,997	834	244	1,078	89.2	369	359	728	27.1	August 9
	79	1,268	o508		508	59.9	370	546	916	20.4	August 24
Totals and Weighted Percentages		29,018			2,080	99.2			2,008	92.8	
$NaClO_3$ - 30% 2.7# per Gallon $CaCl_2$ 15% 1.4# per Gallon pH 6.5 Glue	4	No Record						**5	**5		June 17
	26	6,929	530	174	704	89.8	224	136	360	94.8	July 15

* South half plots; others are east half plots.
** Figures excluded from calculations of totals and percentages because complete records for the three years were not available.
o Figures represent surviving and new stem combined.

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TABLE NO. 11

RESULTS PRODUCED BY EXPERIMENTAL SPRAYS APPLIED TO R. INERME AT CLARKIA, IDAHO
DATA TAKEN 1931 FROM PLOTS SPRAYED IN 1929.

Spray Formula	Plot Number "B" Half	Feet of Live Stem Before Spraying 1929	Feet of Live Stem 1930			Percentage of Live Stem Reduction 1929-1930	Feet of Live Stem 1931			Percentage of Live Stem Reduction 1929-1931	Date of Spray Application 1929
			Surviving	New	Total		Surviving	New	Total		
$NaClO_3$ - 5% .45# per Gallon pH 6.5 Glue	23(1)	14,215	5,556	2,819	8,375	41.1	3,577	2,004	5,581	60.7	July 11
	43(1)	186	49	58	107	42.5	86	51	137	26.2	July 26
	62(1)	0	0	0	0		0	0	0		August 8
	77(1)	0	0	0	0		0	0	0		August 23
Totals and Weighted Percentages		14,401			8,482	41.1			5,718	60.3	
$NaClO_3$ - 10% .89# per Gallon pH 6.5 Glue	*1	No Record					**858	**284	**1,142		June 17
	23	9,001	2,286	1,608	3,894	56.7	1,454	1,072	2,526	72.0	July 11
	43	No Record					**53	**35	**88		July 26
	62	No Record					**42	**25	**67		August 8
	*77	0	0	0	0		0	0	0		August 23
Totals and Weighted Percentages		9,001			3,894	56.7			2,526	72.0	
Atlacide - 7.5% .68# per Gallon pH 6.5 Glue	44	1,303	613	103	716	45.1	409	227	636	51.2	July 26
	63	0	0	0	0		0	0	0		August 9
	78	0	0	0	0		0	0	0		August 23
Totals and Weighted Percentages		1,303			716	45.1			636	51.2	
$NaClO_3$ - 5% .45# per Gallon $CaCl_2$ 2.5% .23# per Gallon pH 6.5 Glue	25(1)	2,394	998	493	1,491	37.6	353	456	809	66.3	July 12
	45(1)	6,186	2,032	575	2,607	57.9	1,192	758	1,950	68.5	July 27
	64(1)	0	0	0	0		0	0	0		August 9
	*79(1)	0	0	0	0		0	0	0		August 24
Totals and Weighted Percentages		8,580			4,098	52.2			2,759	67.9	
Atlacide - 15% 1.36# per Gallon pH 6.5 Glue	46	590	346	65	411	18.1	76	65	141	76.1	July 27
	65	0	0	0	0		0	0	0		August 10
	*80	No Record					**40	0	0		August 24
Totals and Weighted Percentages		590			411	18.1			141	76.1	
$NaClO_3$ - 10% .89# per Gallon $CaCl_2$ 5% .47# per Gallon pH 6.5 Glue	3	No Record					**1,060	**571	**1,631		June 17
	25	3,390	892	534	1,426	57.9	701	674	1,375	59.4	July 13
	45	1,632	482	227	709	56.6	672	900	1,572	3.6	July 27
	64	649	377	50	427	33.2	82	108	190	70.7	August 9
	79	0	0	0	0		0	0	0		August 24
Totals and Weighted Percentages		5,671			2,562	54.8			3,137	44.6	
$NaClO_3$ - 30% 2.7# per Gallon $CaCl_2$ 15% 1.4# per Gallon pH 6.5 Glue	4	No Record					**1,020	**407	**1,427		June 17
	26	3,278	746	304	1,050	67.9	614	255	869	73.5	July 15

* South half plots; others are east half plots.

** Figures excluded from calculations of totals and percentages because complete records for the three years were not available.

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TABLE NO. 12

RESULTS OF EXPERIMENTAL SPRAYS APPLIED TO R. LACUSTRE AT CLARKIA, IDAHO
DATA TAKEN 1931 FROM PLOTS SPRAYED IN 1929.

Spray Formula	Plot Number "B" Half	Feet of Live Stem Before Spraying 1929	Feet of Live Stem 1930			Percentage of Live Stem Reduction 1929-1930	Feet of Live Stem 1931			Percentage of Live Stem Reduction 1929-1931	Date of Spray Application 1929
			Surviving	New	Total		Surviving	New	Total		
NaClO - 5% .45# per Gallon pH 6.5 Glue	23(1)	40	35	25	60	#50.0	0	0	0	100.0	July 11
	43(1)	593	173	49	222	62.5	155	86	241	59.4	July 26
	62(1)	529	169	22	191	63.9	214	73	287	45.8	August 8
	77(1)	536	o290		290	45.9	239	48	287	46.5	August 23
Totals and Weighted Percentages		1,698			763	56.6			815	52.0	
$NaClO_3$ - 10% .89# per Gallon pH 6.5 Glue	*1	No Record					**541	**349	**890		June 17
	23	0	0	0	0		0	0	0		July 11
	43	2,353	316	217	533	77.3	288	131	419	82.2	July 26
	62	273	96	26	122	55.3	33	7	40	85.3	August 8
	*77	125	o96		96	23.2	195	64	259	#107.2	August 23
Totals and Weighted Percentages		2,751			751	72.7			718	73.9	
Atlacide - 7.5% .68# per Gallon pH 6.5 Glue	44	986	503	101	604	38.7	732	164	896	9.2	July 26
	63	2,098	942	228	1,170	44.1	767	412	1,179	43.8	August 9
	78	1,728	o1,296		1,296	25.2	1,398	609	2,007	#16.1	August 23
Totals and Weighted Percentages		4,812			3,070	36.2			4,082	15.2	
$NaClO_3$ - 5% .45# per Gallon $CaCl_2$ 2.5% .23# per Gallon pH 6.5 Glue	25(1)	0	0	0	0		0	0	0		July 12
	45(1)	2,316	869	153	1,022	55.8	905	311	1,216	43.3	July 27
	64(1)	1,665	938	30	968	41.5	467	298	765	54.0	August 9
	*79(1)	97	o68		68	29.9	85	37	122	#20.5	August 24
Totals and Weighted Percentages		4,078			2,058	49.7			2,103	48.5	
Atlacide - 15% 1.36# per Gallon pH 6.5 Glue	46	1,888	794	111	905	51.9	711	128	839	55.3	July 27
	65	1,033	664	69	733	29.1	480	99	579	43.9	August 10
	*80	442	o357		357	74.6	8	4	12	97.3	August 24
Totals and Weighted Percentages		3,363			1,995	40.7			1,430	57.5	
$NaClO_3$ - 10% .89# per Gallon $CaCl_2$ 5% .47# per Gallon pH 6.5 Glue	3	No Record					**80	**20	**100		June 17
	25	68	66	26	92	#35.3	4	9	13	80.9	July 13
	45	808	181	81	262	67.5	284	0	284	64.9	July 27
	64	2,598	916	159	1,175	54.8	428	900	1,328	48.8	August 9
	79	123	o91		91	26.1	367	105	472	#283.5	August 24
Totals and Weighted Percentages		3,597			1,620	55.0			2,097	41.7	
$NaClO_3$ - 30% 2.7# per Gallon $CaCl_2$ 15% 1.4# per Gallon pH 6.5 Glue	4	No Record					**25	**15	**40		June 17
	26	0	0	0	0		0	0	0		July 15

* South half plots; others are east half plots.
** Figures excluded from calculations of totals and percentages because complete records for the three years were not available.
o Figures represent surviving and new stem combined.
Increase.

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For the reasons set forth, it is very necessary to exercise caution in interpreting results obtained from experimental work of this nature.

Following are some conclusions that may be safely drawn from the work as it has progressed to date.

R. petiolare in the "A" group of half plots. (See Table No. 7.)

1. Fairly high percentages of R. petiolare live-stem reduction are accomplished when chlorate sprays are applied upon two successive years. Checking done the year following the final application of spray shows this reduction to be from 90 to 100 per cent of the live stem existing at the time the first spray was applied.

2. Variation of the concentration of chlorate in the spray between the limits of 5 and 30 per cent as sodium chlorate does not materially affect the percentage of R. petiolare live-stem reduction under the conditions noted in 1 above.

3. The presence in the spray of calcium chloride in the proportion of 1 molecular weight of calcium chloride to 2 molecular weights of sodium chlorate does not greatly lower the percentage of R. petiolare live-stem reduction under the conditions noted in 1 above.

4. The figures for percentage bush kill given in Table No. 7, while quite irregular, indicate that 10 per cent sodium chlorate with calcium chloride gave slightly better results with R. petiolare than any of the other sprays considered. The nature of the data does not permit further deductions.

R. inerme and R. lacustre in the "A" group of half plots.
(See Tables No's. 8 and 9.)

Extreme variability is encountered here and about all that can be said is that while 10 per cent sodium chlorate without calcium chloride gave slightly better results than any of the other sprays, none of the treatments satisfactorily reduced either the live stem or number of bushes of these two species.

"B" group of half plots. (See Tables No's. 10, 11, 12 and 13.)

A study of the data collected from this group of plots permits some very interesting observations. It will be recalled that in contract to the treatment given the "A" group, the "B" group received an application of spray only in 1929 and not in 1930. These plots were checked in 1930 and again in 1931. A comparison of the live stem present at the times of checking in 1930 with that present in 1931 should give some indication of the rate at which the Ribes species concerned recover after being damaged by chlorate sprays. Table No. 13 is an attempt at such a comparison.

TABLE NO. 13

CHANGE IN AMOUNT OF RIBES LIVE STEM PRESENT ON HALF PLOTS SPRAYED ONLY IN 1929 FOR THE PERIOD 1930 TO 1931. FIGURES GIVEN ARE WEIGHTED PERCENTAGES OF THE TOTAL LIVE STEM PRESENT BEFORE SPRAYING.

Spray	R. petiolare	R. inerme	R. lacustre
5% $NaClO_3$	7.2 decrease	19.2 decrease	4.6 increase
10% $NaClO_3$	1.7 do	15.3 do	1.2 decrease
7½% Atlacide	3.4 increase	6.1 do	21.0 increase
5% $NaClO_3$ plus 2½% $CaCl_2$	1.7 decrease	15.7 do	1.2 do
15% Atlacide	1.6 do	58.0 do	16.8 decrease
10% $NaClO_3$ plus 5% $CaCl_2$	0.1 increase	10.2 increase	13.3 increase
30% $NaClO_3$ plus 15% $CaCl_2$	5.0 decrease	5.6 decrease	

It is immediately evident from the figures given above that the three species listed are not at all alike in their ability to regain live-stem length lost through damage by chlorate sprays. In fact, in most instances, R. petiolare and R. inerme not only failed to start to recover but experienced a further reduction of live stem during the period of investigation. This loss of live stem during the second year after spraying is very pronounced in the case of R. inerme. The behavior of R. lacustre is extremely irregular and cannot be correlated with any known facts. It is also impossible at the present time to explain the difference existing between the figures for R. petiolare and R. inerme. If further investigation discloses this "residual effect" of spraying, here observed in the case of R. inerme, to be general for any species of Ribes, it will become important to discover what factors are responsible for its existence.

C. Experiments Conducted in Idaho, California, Oregon, and Washington During 1931 Field Season

Idaho: Chlorate sprays were applied to 26 one-quarter-acre plots at Clarkia. These plots had also been treated in 1929. The sprays used in 1931 were of the same composition and were applied on or about the same day of the year as those of 1929. This series of one-quarter-acre

plots has been referred to in Section D as the "B" group of half plots. A summary of the treatments applied is given in Table No. 14.

California: Four methods of application and a number of chemicals, some of which were new to Ribes work, were used in the experimental applications made this year near Strawberry in the Stanislaus National Forest. Table No. 15 summarizes this work.

Oregon: Only one experimental application was attempted in Oregon during this field season. The description of the plot and treatment follows:

Plot I (1930).
Location of plot: One hundred and fifty-five feet northwest of Plot I (1930), Crater Lake National Park.
Size of plot: Fifteen by thirty feet.
Species: R. erythrocarpum (100 per cent ground cover).
Date of treatment: August 8, 1931.
Method of Application: Foliage and surface drench.
Soil: Dry and porous, covered with 1½ inches of fir-needle duff.

Washington: For the six years preceding 1931 an area at Santa, Idaho, was used for most of the field work in connection with chemical investigations involving R. petiolare, R. inerme, R. lacustre, and R. viscossissimum. With the close of the 1930 field season the Santa area was finally depleted of sites suitable for further work of this nature and it was decided that a new location would be needed for future field programs. Accordingly, a number of possible locations were scouted early in the 1931 field season. The one that was finally selected as being the most desirable for the purpose contemplated is in the Wenatchee National Forest in Washington and extends upwards along the courses of Swauk and Iron creeks from their junction, which point is approximately two miles southwest from Blewett Pass in the Wenatchee Mountains.

The new area abounds in a number of species of Ribes, including the four principal ones of north Idaho. Both dry land and swamp types of R. inerme are particularly abundant here. Western white pine is a minor species in this locality and as a consequence, it is unlikely that the area will soon be disturbed by the rapidly growing eradication program.

Experimental applications were made this year on the new area and are summarized in Table No. 16. It will be noted that several applications were made to R. bracteosum in the Snoqualmie National Forest. These plots are located near Steven's Pass which is not far from the main area at Blewett Pass.

TABLE NO. 14

SUMMARY OF EXPERIMENTAL SPRAYS APPLIED AT CLARKIA, IDAHO
DURING 1931 FIELD SEASON

Spray Formula	Plot Number B Half	Gallons of Spray Used	Air Temperature in Degrees Fahrenheit at Time of Application	Per Cent Relative Humidity at Time of Application	Date of Application	Remarks
	23(1)	24	75	51	July 13	Slight rain followed application.
$NaClO_3$ - 5%	43(1)	11	69	55	July 28	
.45# per Gallon	62(1)	3	64	43	August 11	
pH 6.5	77(1)	2	73	43	August 24	
Glue						
	*1	7	58	57	June 23	
$NaClO_3$ - 10%	23	18	70	48	July 14	Plot 80 per cent under water.
.89# per Gallon	43	10	84	35	July 28	
pH 6.5	62	4	76	29	August 11	
Glue	*77	3	73	43	August 24	
Atlacide - 7.5%	44	13	73	78	July 29	Heavy rain followed application.
.68# per Gallon						Spray re-applied after rain.
pH 6.5	63	11	82	18	August 11	
Glue	78	6	86	24	August 24	
	25(1)	10	70	48	July 14	
$NaClO_3$ - 5%	45(1)	20	75	70	July 29	
.45# per Gallon	64(1)	12	77	18	August 12	
$CaCl_2$ 2.5% .23# per Gal. pH 6.5 Glue	*79(1)	17	74	24	August 25	Plot mostly under water.
Atlacide - 15%	46	18	82	37	July 31	
1.36# per Gallon	65	5	85	11	August 13	
pH 6.5 Glue	*80	7	74	37	August 26	Whole area under water.
	3	9	58	57	June 24	
$NaClO_3$ - 10% .89#	25	11	69	59	July 15	
per Gallon $CaCl_2$	45	14	84	30	July 30	Heavy rain followed application.
5% .47# per Gallon						Spray re-applied after rain.
pH 6.5	64	10	74	24	August 13	
Glue	79	14	89	23	August 25	Whole area under water.
$NaClO_3$ - 30% 2.7#						
per Gallon $CaCl_2$						
15% 1.4# per Gallon	4	8	58	57	June 24	
pH 6.5 Glue	26	10	74	40	July 15	Plot mostly under water.

*South half plots; all others are east half plots.

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TABLE NO. 15

SUMMARY OF EXPERIMENTAL TREATMENTS APPLIED IN THE STANISLAUS NATIONAL FOREST DURING 1931 FIELD SEASON

Plot Number Section and Station	Location	Ribes Species	Number Bushes Treated	Chemical Used	Method of Application	Date of Application
1 A (0-1)	Cow Creek	R. roezli	158	$K_3[Cr(CNS)_6]$	Number 1	June 22
2 B (0-1)	Cow Creek	R. roezli	96	$NaClO_3$	Number 1	June 22
3 C (0-1)	Cow Creek	R. roezli	127	Cu_2Cl_2	Number 1	June 23
4 D (0-1)	Cow Creek	R. roezli	68	$Na_3Cu(CN)_4$	Number 1	June 24
5 A (1-2)	Cow Creek	R. roezli	148	X*	Number 1	June 24
6 B (1-2)	Cow Creek	R. roezli	163	$CuSO_4$	Number 1	June 25
7 C (1-2)	Cow Creek	R. roezli	39	X	Number 1	June 26
8 D (1-2)	Cow Creek	R. roezli	34	$CuSO_4$	Number 1	June 29
1 A (0-1)	Section 2	R. nevadense	238	SO_2 - 24#	Number 2	June 29
1 A (0-1)	Gooseberry Camp	R. cereum	No Record	SO_2 - 16#	Number 2	June 30
9 C (2-3)	Cow Creek	R. roezli	35	X	Number 1	July 8
10 D (2-3)	Cow Creek	R. roezli	22	X	Number 3	July 9
1 D (2-3)	Spring Gap	R. roezli	36	L. W. Collin's Weed Killer 4# per Gallon	Number 4	July 11
11 A (2-3)	Cow Creek	R. roezli	No Record	L. W. Collin's Weed Killer 1# per Gallon	Number 5	July 11
12 A (3-4)	Cow Creek	R. roezli	No Record	L. W. Collin's Weed Killer 1/2# per Gallon	Number 5	July 11
13 C (3-4)	Cow Creek	R. roezli	41	$CuSO_4$	Number 1	July 13
14 D (3-4)	Cow Creek	R. roezli	44	$CuSO_4$	Number 1	July 13
16 C (4-5)	Cow Creek	R. roezli	51	X	Number 1	July 15
15 B (2-3)	Cow Creek	R. roezli	30	$CuSO_4$	Number 1	July 20
17 B (3-4)	Cow Creek	R. roezli	38	$CuSO_4$	Number 1	July 20
18 C (5-6)	Cow Creek	R. roezli	70	X	Number 1	July 22
19 D (4-5)	Cow Creek	R. roezli	41	X	Number 1	July 22
21 A (4-5)	Cow Creek	R. roezli	92	X	Number 6	July 23
20 D (5-6)	Cow Creek	R. roezli	75	$CuSO_4$	Number 1	July 24
22 A (5-6)	Cow Creek	R. roezli	71	X	Number 1	July 24
2 A (5-6)	Gooseberry Camp	R. cereum	7	$CuSO_4$	Number 1	August 6
23 A (6-7)	Cow Creek	R. roezli	86	C_2H_4O - 5#	Number 2	August 8
24 B (4-5)	Cow Creek	R. roezli	145	X	Number 7	August 20
25 B (5-6)	Cow Creek	R. roezli	5	$K_3[Cr(CNS)_6]$	Number 1	August 20
26 C (6-7)	Cow Creek	R. roezli	No Record	NH_4CNS - .42# per Gallon	Number 5	August 22
27 C (7-8)	Cow Creek	R. roezli	No Record	NH_4CNS - .84# per Gallon	Number 5	August 22
28 C (8-9)	Cow Creek	R. roezli	No Record	NH_4CNS - 1.25# per Gallon	Number 5	August 22
29 C (9-10)	Cow Creek	R. roezli	No Record	NH_4CNS - 1.76# per Gallon	Number 5	August 22
30 C (10-11)	Cow Creek	R. roezli	No Record	NH_4CNS - 2.1# per Gallon	Number 5	August 22
31 B (5-6)	Cow Creek	R. roezli	84	$CuSO_4$	Number 1	August 24
3 B (5-6)	Gooseberry Camp	R. cereum	10	X	Number 1	August 27

* Copper Complex

Method Number 1 - Stem injection of chemical as glycerine paste (anhydrous).
Method Number 2 - Soil fumigation; gas.
Method Number 3 - Root injection of chemical as glycerine paste (anhydrous).
Method Number 4 - Chemical applied as dust to aerial plant parts.
Method Number 5 - Spray: one-fourth per cent aqueous solution of glue as spreader. One pint of glue solution to 5 gallons of spray.
Method Number 6 - Crown injection of chemical as glycerine paste (anhydrous).
Method Number 7 - Stem injection of chemical as glycerine paste (hydrous).

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TABLE NO. 16

SUMMARY OF EXPERIMENTAL CHEMICAL TREATMENTS APPLIED IN WASHINGTON DURING THE 1931 FIELD SEASON

Plot Number	Ribes Species	Chemical Used: Chemical	Chemical Used: Per Cent	Chemical Used: Pounds Per Gallon	Method of Application	Spray and/or Drench: Total Square Yards	Spray and/or Drench: Total Gallons Solution Applied	Spray and/or Drench: Total Pounds Chemical Applied	Spray: Total Gallons Solution Applied	Spray: Total Pounds Chemical Applied	Drench: Total Gallons Solution Applied	Drench: Total Pounds Chemical Applied	Spray: Gallons Solution Applied Per Square Yard	Spray: Gallons Solution Applied Per Acre	Spray: Pounds Chemical Applied Per Square Yard	Spray: Pounds Chemical Applied Per Acre	Drench: Gallons Solution Applied Per Square Yard	Drench: Gallons Solution Applied Per Acre	Drench: Pounds Chemical Applied Per Square Yard	Drench: Pounds Chemical Applied Per Acre
Wenatchee National Forest																				
IA 0 -.33	R. inerme	NH_4CNS	5	.42	Spray	121.0	15.0	6.30	15.0	6.30			.1240	560.00	.0520	252				
IA .33 -.60	R. inerme	NH_4CNS	7-1/2	.63	Spray	99.0	15.0	9.45	15.0	9.45			.1520	733.00	.0956	462				
IA .60 -.84	R. inerme	NH_4CNS	10	.84	Spray	125.0	15.0	12.60	15.0	12.60			.1200	582.00	.1010	489				
IA .94 -1.0 IIA 0 -.57	R. inerme	NH_4CNS	15	1.25	Spray	231.0	30.0	37.50	30.0	37.50			.1300	630.00	.1630	790				
IIA .57 - .84	R. inerme R. petiolare	Atlacide	10	.84	Spray	136.0	15.0	12.60	15.0	12.60			.1100	533.00	.0930	450				
IIB 0 - .30	R. inerme R. petiolare	NH_4CNS	5	.42	Spray and Soil Drench	110.0	45.0	18.90	15.0	6.30	30.0	12.60	.1360	658.00	.0570	276	.273	1.322	.1150	556
IIB .30 -.60	R. inerme R. petiolare	Atlacide $NaClO_3$	10 5	.84 .42	Spray and Soil Drench	110.0 110.0			15.0	12.60	30.0	12.60	.1360	658.00	.1550	557	.273	1.322	.1150	555
IIC 0 - .33	R. inerme R. petiolare	Atlacide X (1)	10 5	.84 .42	Spray and Soil Drench	121.0 121.0			15.0	12.60	40.0	16.80	.1240	600.00	.1040	504	.331	1.604	.1390	674
IIC (E.33 -.54 (W.33 -.61	R. inerme	$Na_2Cr_2O_7$	10	.84	Spray and Soil Drench	90.0	38.0	31.90	9.5	7.97	28.5	23.95	.1050	509.00	.0880	426	.316	1.530	.2660	1.288
IIC (E.54 -.66 (W.61 -.71	R. inerme	$Na_2Cr_2O_7$	15	1.25	Spray and Soil Drench	40.0	30.0	37.50	7.0	8.75	23.0	28.70	.1740	843.00	.2160	1.055	.575	2.785	.7190	3.475
IIC (E.66 -.90 (W.71 -.90	R. inerme R. petiolare	NH_4CNS	5	.42	Soil Drench	79.0	30.0	12.60			30.0	12.60					.380	1.839	.1600	775
IIIA .34 -.66	R. inerme	X	5	.42	Soil Drench	118.0	60.0	25.20			60.0	25.20					.509	2.461	.2140	1.035
IVA 0 -.54*	R. inerme	Diesel Oil	100		Spray and Soil Drench	198.0	50.0		15.0		35.0		.0756	365.00			.177	858		
IVA .54 -1.0	R. inerme	Diesel Oil	100		Soil Drench	169.0	55.0				55.0						.325	1.574		
VA 0 -.33	R. inerme	X	10	.84	Soil Drench	121.0	60.0	50.40			60.0	50.40					.495	2.395	.4160	2.010
VA .33 -.64	R. inerme	Atlacide	10	.84	Spray and Soil Drench	114.0	75.0	63.00	15.0	12.60	60.0	50.40	.1310	635.00	.1120	543	.525	2.540	.4410	2.134
VIA 0 -1.0	R. inerme R. lacustre	X Paste			Injection	367.0	0.5						** .0014	** 6.78						
VIIA-B 0 -1.0	R. lacustre	X Paste			Injection	733.0	0.5						** .0007	** 3.39						
VIII 0 -1.0	R. lacustre	X Paste			Injection															
IXA 0 -.??	R. petiolare	$NaClO_3$	10	.84	Spray	Partial Defoliation Experiment on R. petiolare														
XA 0 -1.0	***	X			Tubulation															
XIA 0 -1.0	***	X			Tubulation															
XIIB 0 -.25	R. inerme	NH_4CNS	5	.42	Subsurface Drench	91.7	115.0	50.50			115.0	50.50					1.250	6.050	.5260	2.540
XIIB .25 -.49	R. inerme	NH_4CNS	5	.42	Subsurface Drench	88.0	60.0	25.80			60.0	25.80					.682	3.300	.2870	1.388
XIIIA 0 -.59	R. inerme R. petiolare	X	5	.42	Subsurface Drench	172.0	170.0	73.10			170.0	73.10					.990	4.790	.4160	2.010
XIIIA .59 -.75	R. inerme	X	5	.42	Subsurface Drench	58.7	130.0	55.90			130.0	55.90					2.210	10.650	.9300	4.480
XIIIA .75 -1.0	R. inerme	$ZnSO_4$	5	.42	Subsurface Drench	91.7	150.0	64.50			150.0	64.50					1.630	7.895	.6850	3.315
XIIIB 0 -.32	R. inerme R. petiolare	Atlacide	10	.84	Spray and Soil Drench	117.3	75.0	63.00	15.0	12.60	60.0	50.40	.1280	620.00	.1080	521	.511	2.473	.4300	2.075
XIIIB$_1$ .32 -.66	R. inerme	Atlacide	10	.84	Spray and Soil Drench	68.0	41.0	34.40	3.0	2.52	38.0	31.90	.0440	213.00	.0370	179	.456	2.205	.3830	1.853
XIIIB$_2$ .32 -.66	R. inerme	$NaClO_3$	5	.42	Subsurface Drench	56.7	55.0	23.80			55.0	23.80					.970	4.690	.4075	1.970
XIV 0 -.40	R. inerme R. petiolare	NH_4CNS	5	.42	Subsurface Drench	73.4	60.0	26.00			60.0	26.00					.816	2.955	.3440	1.660
XV - XIX inc.	***	X			Tubulation															
XX 0 -.14	R. inerme	C_2H_4O	15	1.25	Subsurface Drench	51.3	8.0	10.00			8.0	10.00					.156	755	.1950	944
Stevens Pass, Snoqualmie National Forest																				
I 0 -.50	R. bracteosum	X Paste			Injection	183.3	0.5						** .0027	** 13.07						
II 0 -.70	R. bracteosum	NH_4CNS	5	.42	Spray and Crown Drench	257.0	60.0	25.80	20.0	8.60	40.0	17.20	.0780	378.00	.0330	159	.156	755.0	.0635	317
II .70 -1.0	R. bracteosum	NH_4CNS NH_4CNS	10 5	.84 .42	Spray and Crown Drench	110.0 110.0	30.0	16.80	10.0	8.40	20.0	8.40	.0910	441.00	.0764	371	.182	881.8	.0765	370

(1) Copper Complex.
* Actual area treated two-thirds of area in plot. Figures given for quantities per unit area should be divided by 2/3 to give true values.
** Injection chemicals.
*** Contains R. lacustre, R. inerme, R. petiolare and R. watsonianum.
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Field work in connection with experimental studies on the translocation of foreign substances in Ribes plants. Mention of this division of the 1931 field work was made in the introduction to the present report. It is impractical to discuss here, except in the briefest possible fashion, the purposes these experiments are intended to serve, nor is it possible to give more than a very broad outline of the technical methods employed. As stated before, the studies are an inquiry into the extent and manner of distribution throughout the plant body of substances that have been introduced into severed or split stems or roots.

Chemical pastes have been injected into split plant parts under a variety of recorded circumstances. Some of the plants so treated have been dug up and dissected at varying recorded intervals of time after the injections were made. The dissected plants have been preserved for chemical analysis. The remaining plants treated by the paste-injection method were left in situ for examination in 1932.

Tubes containing aqueous solutions of dyes or chemicals, or containing water only, were affixed to cut ends of stems and roots under a variety of conditions. The rate at which the solution was absorbed by the plant as well as the quantity of solution taken up was carefully determined and recorded. These treatments were made at various hours in the day throughout the season. Duration of treatment was altered according to a definite plan. Extensive records of all these experiments have been kept. They include detailed notes concerning the plants treated and the environmental circumstances prevailing, such as exposure, shade, temperature and moisture in the soil and air at the time experiments were performed, as well as general weather observations.

D. Late Season Observations on 1931 Field Experiments in Washington and California.

Comparison of plants treated with ammonium thiocyanate with those to which chlorate was applied indicates that ammonium thiocyanate is quite as toxic to plant tissue as chlorate. Some doubt exists as to whether or not full advantage can be taken of this fact due to the ease and rapidity with which ammonium thiocyanate may break down under the influence of many biological agencies with the consequent formation of non-toxic substances.

The principle of soil treatment tried so extensively this year appears at present to offer possibilities for the development of methods of treatment supplementary to those being used at present. Nothing further can be said regarding this type of application until after the 1932 checking has been performed.

The experiments performed this season in which glycerine pastes were injected into plant stems again demonstrated the high toxicity of copper complex to plant tissue but at the same time seemed to show that this method of application did not provide the proper opportunity for perfect distribution of the chemical to the vital parts of the plant. Practical difficulties of application also oppose the adoption of this method of treatment.

Ethylene oxide, a chemical highly recommended by certain workers, appears worthless as a ribicide.

Fire hazard investigations conducted during 1931 field season. A special set of experiments planned for the purpose of investigating the tendency for sodium chlorate and sodium chlorate-calcium chloride mixtures to promote "spontaneous" ignition when in contact with plant materials was performed in the Wenatchee National Forest. The results of these and other experiments dealing with the same subject are soon to be submitted in a separate report.

RECOMMENDATIONS FOR LARGE-SCALE APPLICATIONS OF CHEMICALS, 1932.

The findings obtained from the investigative work accomplished during the past year do not permit making radical changes in the recommendations submitted in the 1930 annual report until certain further experiments now in progress are completed.

The following general observations are based upon a comprehensive study of the information at present available: It has been found that when the concentration of chemical in any particular type of spray is changed within the limits of field practice, the difference in the effects produced due to this variation is frequently overshadowed by the difference in effects produced due to a change in the total quantity of chemical applied per plant unit. Thus, a heavy drenching with dilute spray is sometimes more effective than a light application of spray in which the concentration of chemical is high. This is particularly true when the weight of active chemical used is larger in the first instance than it is in the last.

It is becoming increasingly evident that the soil solution can function as an effective medium for the distribution of toxic substances to the vital plant parts.

The foregoing observations make it desirable to re-emphasize the necessity for complete spray coverage of aerial plant parts and to recommend that spray be liberally applied to the base of the plant and the soil immediately surrounding the stems.

The experiments performed during 1930 in California have shown that R. roezli growing upon dry sites can be successfully eradicated by the application of Diesel oil as a thorough spray and crown drench. If the plants are heavily layered, more oil must be applied than when they are erect. Wet soil prevents successful eradication by this method. The feasibility of this method must be determined in practice by the cost of oil treatment as compared to hand eradication.

PART II

INVESTIGATIONS IN CHEMICAL METHODS FOR THE ERADICATION OF BARBERRY

INTRODUCTION

Under the terms of the cooperative agreement, which has been in effect since April 15, 1930, between the Division of Blister-Rust Control and the Division of Barberry Eradication, further work has been performed for the purpose of developing practical methods for the eradication of barberry. This work has paralleled in a large measure the morphological, physiological, and chemical investigative work that has been done with Ribes, which latter is given in Part I of this report.

The experience and information gained through laboratory and greenhouse work and the results of the field program of 1930 were applied to the formulation of plans for further field work which was undertaken during 1931.

The program of research thus far completed has been devoted largely to a study of fundamental principles involved in the chemical eradication of barberry. The brief summary of the work here given is for the purpose of indicating the course and scope of the laboratory program and is to serve as an introduction to the discussion of the field experiments.

SUMMARY OF RESEARCH WORK 1930-1931

A. Culture of Barberry Plants Under Greenhouse Conditions

Stocks of growing barberry plants have been maintained in the greenhouses at Berkeley, California and Moscow, Idaho for utilization in the research program.

The plants have shown themselves to be readily adaptable to cultivation when grown in either water-culture solution or soil. Both methods have been used; the choice of method depending upon the purpose for which the plant was to be used.

B. Chemical Work

A number of tannin determinations have been made upon samples of barberry plants. These indicate low tannin levels for this plant species. Tannin was found in only very small quantities in the aerial parts and not at all in the roots of the plants examined.

High tannin content, other factors being equal, is generally associated with high resistance to injury by chemicals. Consideration of the occurrence and chemical characteristics of tannins in a plant enables the

experimenter to select toxic chemicals and methods of treatment which will minimize the ability of tannins to shield the plant from injury. The same type of study can be applied to other classes of plant extractives.

Just as it is sometimes possible for carbohydrates other than starch to perform the functions of starch in the economy of the plant, so may other plant materials take the place of tanning. It is not definitely known at present whether or not barberry contains large quantities of other substances capable of affording to the plant the same type of protection against toxic chemicals as is given by the presence of large quantities of tannin. Further analyses are being performed which will yield information on this subject. A study is also being made of the kind and quantity of carbohydrates occurring in barberry plants.

C. Physiological Work

Several series of experiments have been performed for the purpose of testing the resistance of barberry plants to the action of toxic substances. From the results of one series it was found that barberry plants whose roots were exposed to solutions of sodium chlorate in concentrations as low as 100 parts per million died after an exposure of 11 weeks. Two hundred and fifty parts of sodium chlorate per million parts of culture solution killed barberry plants under the same conditions of treatment in five weeks. Concentrations of 50 parts per million or lower failed to kill the plants in 14 weeks. These results show that barberry is relatively non-resistant to the action of chlorate as compared to some other plant species which were investigated in another series of tests. The effects of a large variety of other chemicals upon barberry were compared with the effects produced by the same chemicals upon a number of species of Ribes. These experiments also showed barberry plants to be relatively non-resistant to the toxic action of chemicals when the treatment was applied under greenhouse conditions.

D. Morphological Work

The study of the morphological characteristics of barberry has been undertaken. The purpose of this investigation is to discover the morphological features of this plant that are concerned with the resistance or non-resistance of the species to the effects of toxic chemicals. It is hoped that the discovery of these characteristics may be used to advantage in devising efficient methods of application of chemicals for the purpose of barberry eradication.

Much of the work up to the present time has been concerned with the examination and measurement of structures characteristic to barberry leaves. A full summary of the program thus far completed is soon to be submitted in the form of a separate report which will also include the

morphological work done upon Ribes. Some of the leaf structures and characteristics studied are included in the following list: thickness of epidermal cells and epidermal cell walls, hydathode and stomatal size and frequency, trichome length and frequency, and the ratio of thickness of the palisade layer to the total leaf thickness.

SUMMARY OF 1931 FIELD EXPERIMENTS

A. Recheck of 1930 Experiments in Ohio.

The experimental plots that were treated in 1930 at Maumee, Ohio were checked by G. E. Draper and R. U. Swingle. H. R. Offord was also present at the time the check was performed and directed the work.

The results of this work are given in Tables No. 17, 18 and 19 and the discussion that follows.

B. Discussion of Results Obtained from 1930 Experiments

Table No. 17 is a list of the experimental sprays applied to barberry in 1930. Inspection of the table will show that 14 spray chemicals were used.

TABLE NO. 17

COMPOSITION OF EXPERIMENTAL SPRAYS USED AT MAUMEE, OHIO IN 1930

Chemical Used	Concentration in Pounds Per Gallon or Per Cent by Volume	pH of Spray
Ammonium Chloride	2.7	
Atlacide	1.4	6.5
Atlacide	2.7	4.0, 6.5 and 8.0
Atlacide	3.4	6.5
Copper Complex	2.6	6.5 and N. C.
Copper Complex	3.1	6.5 and N. C.
Kerosene	100%	
Kerosene + Phenol	98% + 2%	
Kerosene + Phenol	96% + 4%	
Pitch Oil	100%	
Pitch Oil + Cresylic Acid	98% + 2%	
Pitch Oil + Furfural	95% + 5%	
Pitch Oil + Phenol	98% + 2%	
Pitch Oil + Pyridine	99% + 1%	
Sodium Chlorate	0.25	N. C.
Sodium Chlorate	0.45	6.5
Sodium Chlorate	0.89	4,0, 6.5 and 8.0
Sodium Chlorate	1.4	6.5
Sodium Chlorate	2.7	4.0, 6.5 and 8.0
Sodium Hydroxide	0.3	
Sodium Tetraborate	0.23	
Sulphuric Acid	0.35	
Zinc Ammonium Chloride	2.7	

N. C. = not controlled.

The composition of the sprays varied with respect to the kind and concentration of the chemicals used and the acidity of the spray. These variations bring the number of sprays tested up to 31. Many of the sprays were applied more than once during the season. The total number of spray applications made was 68. It will be unnecessary at this time to give detailed data concerning each of these 68 treatments. Complete records of all experiments are on file for office reference and should be consulted for detailed information beyond that given here.

Atlacide and sodium chlorate were the only spray chemicals of all those applied that consistently yielded bush kills of higher than 75 per cent. The nearest competitor to these two materials was pitch oil, either

oure, or in admixture with minor quantities of other substances. The average bush kill given by pitch oil was 71 per cent. It can be shown that the small quantities of other materials mixed with pitch oil in these experiments were without significant effect. Thus, the highest percentage of bush kill produced by this type of spray was 89 per cent. The particular spray used was composed of 99 per cent of pitch oil and 1 per cent of pyridine, which same formula was also used in spraying a plot that showed a bush kill of only 34 per cent. With one exception, this latter figure was the lowest percentage of bush kill reported for sprays containing pitch oil. The lowest bush kill given by this type of spray was 33 per cent. This was produced by a mixture composed of 98 per cent of pitch oil, and 2 per cent of phenol. Extensive work with Ribes performed in California during 1930 has also shown that the addition to pitch oil of the same quantities of pyridine, furfural, phenol, and cresylic acid was quite without sensible effect upon the toxicity of the pitch oil. Several practical difficulties attend the use of pitch oil as a plant spray. Chief among these is the discomfort experienced by men engaged in handling and applying it. The use of pitch oil has been discontinued in these investigations for this reason.

The results of more extensive trials in which oils were used upon Ribes in California during 1930 have shown that certain cheap petroleum oils are at least as effective if not more effective than pitch oil when used as herbicides. The use of these oils is not accompanied with the same disadvantages that operate against the application of pitch oil. Further study of the effectiveness of oils as herbicides is at present in progress.

Copper complex spray gave a bush kill of 90 per cent on one plot treated at Maumee, but this was an entirely erratic result and cannot be considered as being in any way typical of the action of this kind of spray.

Sodium chlorate and sodium chlorate-calcium chloride mixtures, in contrast with all the other spray materials that were used in the 1930 field experiments, gave uniformly good results in terms of percentages of bushes killed. The only instances in which the use of either of these spray materials resulted in bush kills of less than 96 per cent occurred when sodium chlorate spray was used in the concentration of .25 pound per gallon of water. A condensed summary of the data obtained by checking plots sprayed with chlorate is given in Table No. 18. The data taken from all plots treated with sprays of the same composition and the same pH have been combined in the table to facilitate examination of the results. This grouping is permissible by reason of the uniform character of results produced by chlorate sprays of the same composition. It has been found that such very minor variations as did occur could not be correlated with the time of the season at which the application was made. Inspection of the table will show that it is also impossible to correlate the pH of the spray with effectiveness.

TABLE NO. 18

RESULTS OF 1930 EXPERIMENTAL CHLORATE SPRAYS APPLIED AT MAUMEE, OHIO
DATA TAKEN IN 1931.

Spray Formula	pH of Spray	Area Number	Plot Number	Number Bushes Sprayed	Gallons Spray Used	Feet of Stem Dead in 1931	Per Cent of Stem Dead in 1931	Per Cent Bushes Dead in 1931	Gallons Spray Per 100 Feet of Stem Dead in 1931	Pounds Chemical Per 100 Feet of Stem Dead in 1931
Atlacide 3.4# Per Gallon	6.5	2	16-G; 18-H	250	8.4	2,266	99.9	99.4	0.371	1.26
Atlacide 2.7# Per Gallon	4.0	2	17-H; 16-F_1	194	7.15	1,615	99.9	98.5	0.442	1.19
	6.5	2	19-H_2; 16-F_2	162	5.5	1,423	100.0	100.0	0.387	1.04
	8.0	2	17-(E, F, I); 18-F	151	7.15	2,073	99.9	99.4	0.345	0.93
Atlacide 1.4# Per Gallon	6.5	2	5-(K, L); 19-H_1	113	6.4	1,126	99.9	99.3	0.569	0.80
Sodium Chlorate 2.7# Per Gallon	4.0	1 2	1-E 19-G	161	4.65	1,147	99.6	99.4	0.406	1.09
	6.5	1 2	1-F 16-E	201	6.7	1,686	99.9	99.5	0.398	1.07
	8.0	1 2	0-C 18-G	123	5.65	2,131	100.0	100.0	0.265	0.72
Sodium Chlorate 1.4# Per Gallon	6.5	2 2	20-(G, H); (4, 5)-N 5-0	58	2.4	405	100.0	100.0	0.593	0.83
Sodium Chlorate 0.89# Per Gallon	4.0	1 2 2 2	0-D (0 to 4)-K; (0 to 4)-L (0,1,4,to 7)-M; 1-N (0 to 3)-J	106	6.7	1,204	100.0	100.0	0.556	0.49
	6.5	1	1-D	33	3.4	537	100.0	100.0	0.633	0.56
	6.5	2	4-(H.I)	156	N.R.	407	98.5	98.7		
	8.0	1 2	1-C 2-N	256	4.5	1,334	99.7	99.4	0.337	0.30
Sodium Chlorate 0.45# Per Gallon	6.5	1	2-D	25	1.25	183	99.0	96.1	0.683	0.31
	6.5	2	(6, 7)-N	43	N.R.	175	100.0	100.0		
Sodium Chlorate 0.25# Per Gallon	N. C.	2 2 2 2	(4 to 7)-A;(0 to 7)-B (0 to 3)-C;(5 to 7)-C (3 to 8)-D; 1-E (3 to 8)-E	155	2.6	425	95.7	81.3	0.612	0.15

N.R. No record.
N.C. Not controlled.

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TABLE NO. 19

RESULTS OF 1930 INDIVIDUAL BUSH TREATMENTS MADE AT MAUMEE, OHIO
DATA TAKEN IN 1931.

Chemical Used	Method Number																			
	1		2		3		4		5		6		7		8		9		10	
	Number of Bushes																			
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
Ammonium Chloride		1		1	1		1		1							7		1		5
Arsenic Oxide		1		1						1		2								
Atlacide		2				2								2		9		8		10
Bismuth Subbenzoate	1		1				1		1											
Cadmium Chloride		1		1		1		1		2		1								
Copper Complex		2		1		2	1		1	1		1		2		4		6		5
Copper Sulphate		1		2		2		2		1		1		2						
Ferrous Ammonium Sulphate		2		2	2		1	1	1	1		2		2						
Formaldehyde		2		1	1	1	1													
Furfural						1			1							1				
Kerosene		2		2		1														
Mercuric Chloride		2		2	1	1	2		1	1	1	1				2				
Phenol	1		1		2		1		1		1									
Pitch Oil		1	1	1	1	1	2									8		9		12
Potassium Bichromate		1		1			1		1			1								
Silver Nitrate				1			1													
Sodium Chlorate		2		5		2	1	1		4		4		2		14		7		11
Sodium Chloride		2	1	1	1		1	1	1	1	2									
Sodium Cyanide		1		1		2	1			1		1		1						
Sodium Fluoride		1		1				1		1		1								
Sodium Fluoride + Calcium Chloride 1 to 1 by Weight																4		2		3
Sodium Fluoride + Sodium Hydroxide 1 to 0.3 by Weight																4		2		7
Sodium Nitrite		1		1		1	1		1			1		1						
Sodium Nitroprusside		1		1	1		1		1			1		1						
Sodium Sulphate		2		2		2	2		1	1		2				2				
Sodium Tetraborate		1		1			1		1											
Sulphur Dioxide 8% Solution												1								
Zinc Ammonium Chloride	1	1		1	1		1		1			1		1		5		4		5

Note: Consult list given on preceding page for methods corresponding to method numbers given above.

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If only the figures for concentration of chemical and corresponding percentage of kill were considered, it would appear that a solution containing 0.25 pound of sodium chlorate per gallon of water would be definitely too dilute to be successfully used as a spray. The actual weight of sodium chlorate which was applied per plant unit, rather than the concentration of the chemical in the spray may, however, have been the limiting factor in this instance. Figures representing the weight of chemical applied per 100 feet of stem killed have been calculated and are given in the table. These figures illustrate in a crude way what is meant by the reference that was just made to the quantity of chemical used per plant unit. It is perhaps impossible to devise a mathematical expression by means of which the quantity of chemical necessary to accomplish the death of a plant could be stated with precision. The figures given in the table as weights of chemical used per unit length of stem are only very rough approximations of that quantity which, for want of a better term, has been referred to as the weight of chemical applied per plant unit. An adequate expression of this quantity should take into account a number of variable plant factors not considered in the figures given, as for example, root length, and root and stem volume. Consideration of the data presented in the table with the results of the experimental work as a whole, permits the formulation of fairly definite tentative recommendations for the application of chlorate sprays to barberry. These recommendations will be given at the end of this section of the report.

A large number of experiments were performed in 1930 in which attempts were made to kill individual bushes by the application of very small quantities of chemicals. These experiments, which were preliminary to obtaining an understanding of this general type of treatment, comprised a list of 10 methods of application in which 20 different chemical mixtures were used. The total number of bushes treated in these experiments was 350. The various methods employed in the application of chemical in the tests are given in the following list:

Methods of Application Used in Individual Bush Treatments at Maumee, Ohio, 1930

1. Bush cut off through crown*, groove cut in crown, filled with paste (1-5 grams).

2. Bush cut off through crown, hole bored with a 3/16ths-inch bit and filled with paste (1-5 grams).

3. Crown lacerated and large roots exposed, small quantity of saturated solution (2-4 c.c.) applied.

*The word "crown" as used in this report refers to that part of the stem which is at the base of the plant and immediately above the juncture of the roots with the stem.

4. Top left intact, hole bored into crown and filled with a paste (1-5 grams).

5. One stem cut off at crown, groove cut in crown and filled with a paste (1-5 grams).

6. One stem cut off, piece of rubber tubing fitted on and filled with a saturated solution (5-20 c.c.).

7. Crown grubbed out; paste applied to root ends thus exposed.

8. Surface litter at base of plant removed; a chemical in aqueous solution or solid form applied to soil about crown.

9. Surface litter at base of plant removed; 50 to 75 per cent of surface of exposed portions of roots and crown lacerated; a chemical in saturated aqueous solution or solid form applied to exposed roots and crown.

10. Surface litter at base of plant removed. Bush cut off through crown and chemical either as a solid or in aqueous solution applied about crown.

As has been stated before, these experiments constituted only a preliminary inquiry into the subject of individual bush treatments. The methods of application employed were only intended to serve as general guides for future work of this kind. The same statement also applies to the chemicals used in the experiments. No purpose would be served by giving here a detailed account of the results of each treatment. A complete report of these experiments is on file for office reference and should be consulted for any particulars beyond those given in this discussion.

Table No. 19 is a condensed summary of the results of the individual bush treatments. The figures in the table place the methods of application used in the following order of decreasing effectiveness:

1. Methods Nos. 7, 8, 9 and 10.
2. Method No. 1.
3. Method No. 2.
4. Method No. 6.
5. Method No. 3.
6. Method No. 5.
7. Method No. 4.

It is significant that the application of chemicals by methods Nos. 8, 9 and 10 resulted in every instance in death to the plant treated. The quantity of chemical used in these treatments varied from 25 grams to approximately 680 grams. Only 250 grams or less were applied in the majority of instances. Methods Nos. 1, 2, 6 and 7 also gave very good results. The entire aerial parts of the plants were removed prior to the application of the chemicals according to methods Nos. 1, 2 and 7. This type of treatment, while effective, offers only slight advantage over hand methods of eradication in point of time involved. Method No. 6 appears to offer distinct possibilities as a means of eradication in which only a small quantity of chemical need be used and only very little time is necessary for application of treatment. Should it prove reliable, this method can be utilized as the basis for developing a type of treatment suitable for killing barberry plants without harming other vegetation.

C. Experiments Conducted in Pennsylvania and Colorado During 1931

Pennsylvania. - The major part of the 1931 field program was conducted at Pennsylvania Furnace near Baileyville in Ferguson County, Pennsylvania. Approximately eight acres of land to be used for the experimental work were leased from the owner, C. C. Rider, at the beginning of the field season. Maps of the experimental area are included in the report to show the location of the plots and the scheme used to number these plots.

The work was performed by G. E. Draper assisted by R. U. Swingle. In the absence of H. R. Offord during part of the season, Doctor F. C. Meier, Principal Pathologist in Charge of the Division of Barberry Eradication, directed the work and acted in an advisory capacity.

Methods and herbicides new to this work were tested, and with the guidance of past experience further work was performed with some of the methods and chemicals previously used.

The experiments are described and summarized in Tables Nos. 20, 21, 22, 23 and 24 and in the following text. Table No. 20 lists the experimental spray treatments applied during the year. It will be noted that a short series of experimental sprays were applied to several plots of poison ivy. Study of the problem of the chemical eradication of this troublesome plant is not a part of the regular program of this Division. The results of these few tests will, however, be of general interest. Table No. 21 is a record of a series of experiments in which chemicals were applied to individual bushes. These experiments are similar in pattern to those performed in 1930 and are intended to serve as more extensive tests of certain of the principles brought to light in the first series. The methods of experimentation employed in these tests are given in the following list:

Experimental Methods of Applying Chemicals to Individual Bushes at Pennsylvania Furnace in 1931, Experiments Reported in Table No. 21

1. Special tool was used to inject 1 to 2 grams of chemical in the form of a glycerine paste into split stem.

2. Chemical applied as a solution by means of a tube affixed to the stump of a stem that had been cut off close to the surface of the soil just prior to application.

3. Same method as No. 2 except that chemical was applied through more than one severed stem; the number of stems tubulated depending upon the size of the plant.

4. Solution of chemical poured on the soil about base of the plant close to the stems.

5. Same treatment as No. 4 except that solution was applied in a small stream under heavy pressure.

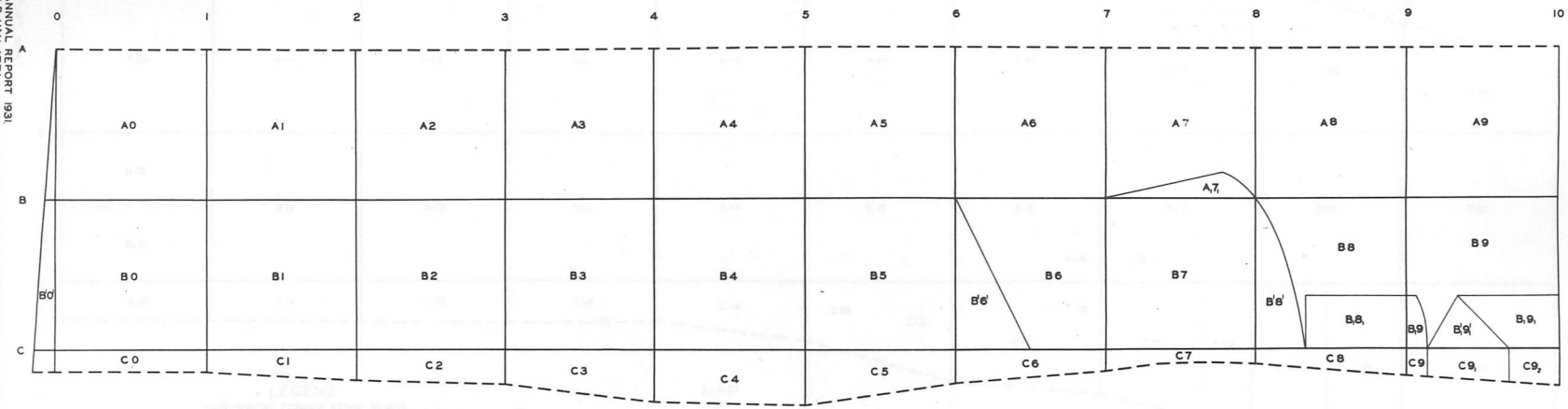
6. Method of treatment was the same as number 5 except that principal stem was split in half at the surface of the soil prior to the application of chemical.

7. Chemical in concentrated solution sprayed upon partially girdled stems close to the surface of the soil.

8. Solid chemical applied to surface of ground close to base of the plant.

9. Chemical applied to soil as gas through holes 10 to 30 inches deep made by means of "gopher stick". Usually 2 to 6 holes per bush.

10. Spray applied to aerial parts.



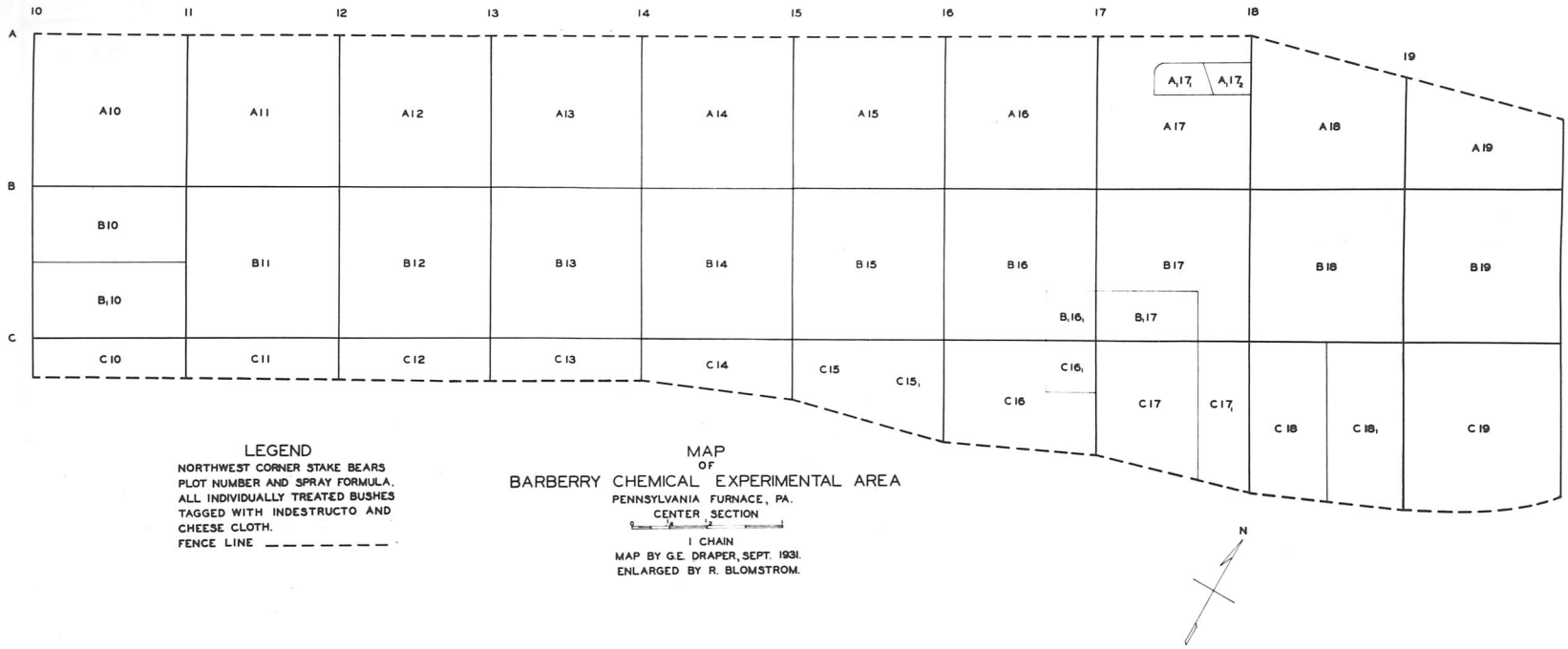
LEGEND

NORTHWEST CORNER STAKE BEARS PLOT NUMBER AND SPRAY FORMULA.
ALL INDIVIDUALLY TREATED BUSHES TAGGED WITH INDESTRUCTO AND CHEESE CLOTH.
FENCE LINE _ _ _ _ _ _

MAP
OF
BARBERRY CHEMICAL EXPERIMENTAL AREA

PENNSYLVANIA FURNACE, PA.
WEST SECTION
0 1/4 1/2
1 CHAIN
MAP BY G.E. DRAPER, SEPT. 1931.
ENLARGED BY R. BLOMSTROM.

N



LEGEND

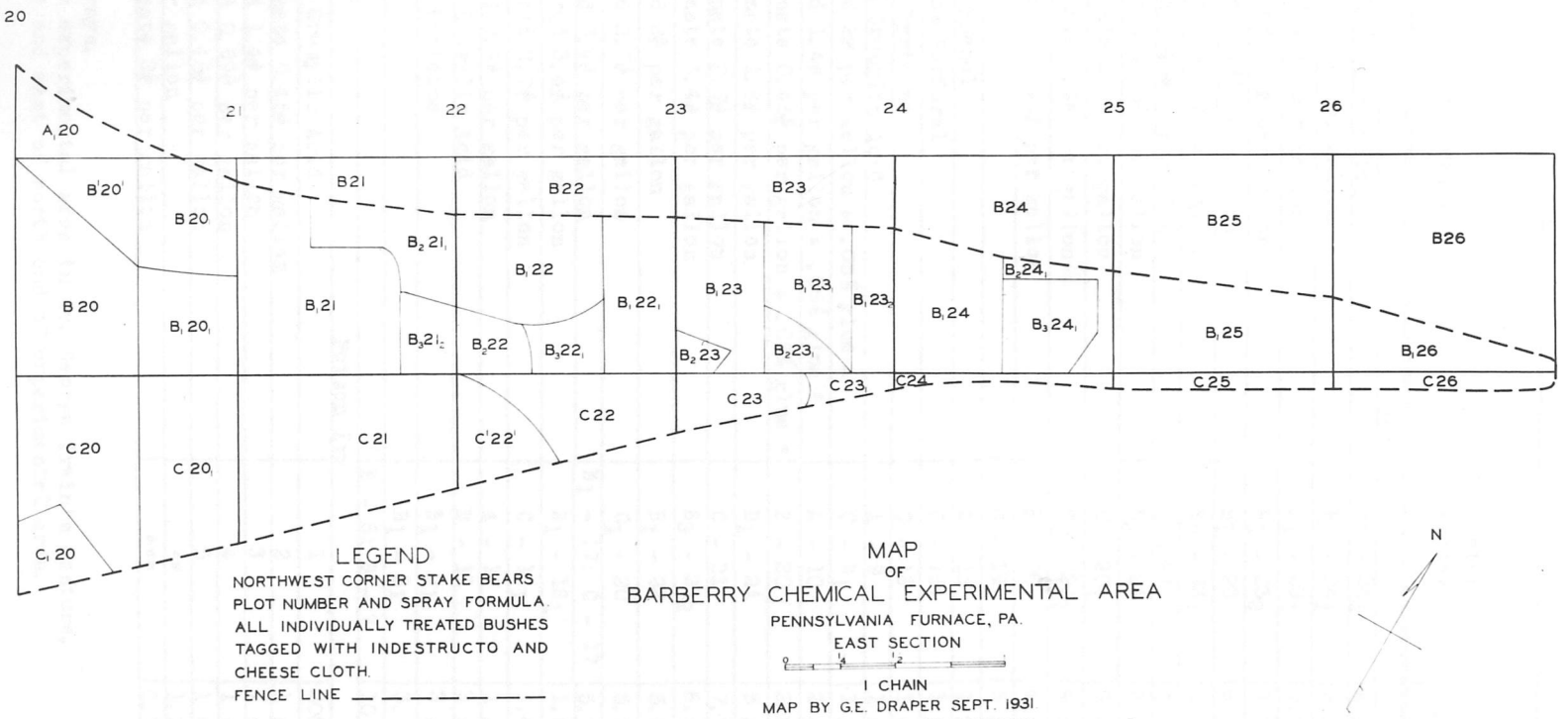
NORTHWEST CORNER STAKE BEARS PLOT NUMBER AND SPRAY FORMULA.
ALL INDIVIDUALLY TREATED BUSHES TAGGED WITH INDESTRUCTO AND CHEESE CLOTH.
FENCE LINE _ _ _ _ _ _ _

MAP
OF
BARBERRY CHEMICAL EXPERIMENTAL AREA
PENNSYLVANIA FURNACE, PA.
CENTER SECTION

1 CHAIN

MAP BY G.E. DRAPER, SEPT. 1931.
ENLARGED BY R. BLOMSTROM.

N



LEGEND

NORTHWEST CORNER STAKE BEARS PLOT NUMBER AND SPRAY FORMULA.
ALL INDIVIDUALLY TREATED BUSHES TAGGED WITH INDESTRUCTO AND CHEESE CLOTH.
FENCE LINE — — — — — —

MAP
OF
BARBERRY CHEMICAL EXPERIMENTAL AREA
PENNSYLVANIA FURNACE, PA.
EAST SECTION

0 1/4 1/2

1 CHAIN

MAP BY G.E. DRAPER SEPT. 1931
ENLARGED BY R. BLOMSTROM

N

TABLE NO. 20

SUMMARY OF EXPERIMENTAL SPRAYS APPLIED AT PENNSYLVANIA FURNACE, PENNSYLVANIA DURING 1931 FIELD SEASON.

Spray Formula	Plot Number	Quantity Spray Applied	Date of Application
Barberry			
Atlacide buffered 2# per gallon	$B_3 - 24_1$	4 gallons	July 16
Atlacide unbuffered 2# per gallon	$B_2 - 24_1$	2.88 gallons	July 16
Atlacide buffered 1.4# per gallon	$B_1 - 23_1$	5.5 gallons	July 17
Atlacide unbuffered 1.4# per gallon	$B_1 - 23_2$	1.75 gallons	July 17
Atlacide buffered 0.89# per gallon	$B_1 - 23$	8 gallons	July 17
Atlacide unbuffered 0.89# per gallon	$B_2 - 23_1$	2 gallons	July 18
Atlacide buffered 0.45# per gallon	C - 23	5.25 gallons	July 18
Atlacide unbuffered 0.45# per gallon	$B_2 - 23$	2 gallons	July 18
Ammonium thiocyanate 2.7# per gallon	$C - 20_1$	6 gallons	July 18
Ammonium thiocyanate 1.4# per gallon	$B_1 - 20_1$	4 gallons	July 18
Ammonium thiocyanate 0.45# per gallon	$B - 20_1$	4.5 gallons	July 18
Furnace Oil	$C - 18_1$	5 gallons	July 20
Furnace Oil + 2% Phenol	C - 15	1.38 gallons	July 20
Furnace Oil + 3.5% Furfural	$C - 15_1$	1 gallon	July 20
Furnace Oil + 2% Pyridine	C - 13	1 gallon	July 20
Furnace Oil + 4% Cresylic Acid	A - 9	1 gallon	July 20
Atlacide buffered 2# per gallon + .05% glue *	$C - 9_1$	1 gallon	July 24
Atlacide buffered 1.4# per gallon + .05% glue *	A - 10	2 gallons	July 24
Ammonium thiocyanate 0.45# per gallon + .05% glue *	B - 20	2.25 gallons	July 24
Ammonium thiocyanate 1.8# per gallon	$B_1 - 21$	5 gallons	August 24
Ammonium thiocyanate 2.7# per gallon	C - 21	7.75 gallons	August 24
Ammonium thiocyanate 3.4# per gallon	$B_3 - 21_2$	6.5 gallons	August 24
Atlacide buffered 2# per gallon	$B_1 - 22$	5.5 gallons	August 25
Atlacide buffered 2.7# per gallon	$C_1 - 20$	5.5 gallons	August 28
Atlacide buffered 3.4# per gallon	$B_1 - 17$; C - 17	5.75 gallons	August 29
Atlacide unbuffered 3.4# per gallon	$B_1 - 16_1$	1.6 gallons	August 29
Atlacide unbuffered 2.7# per gallon	$C - 16_1$	1.4 gallons	August 29
Atlacide buffered 2.7# per gallon	A - 17	1 gallon	August 29
Furnace Oil + 2% Cresylic Acid	B - 11	3 gallons	August 29
Furnace Oil + 5% Pyridine	$B_1 - 9_1$	3 gallons	August 29
Furnace Oil	$B_1 - 8_1$	3.75 gallons	August 29
Diesel Oil	B - 6; B - 7	10 gallons	September 3
Poison Ivy			
Furnace Oil + 2% Cresylic Acid	1	200 c.c.	July 20
Ammonium thiocyanate 0.45# per gallon	2	1 pint	July 20
Atlacide buffered 1.4# per gallon	3	1 pint	July 20
Atlacide buffered 0.89# per gallon	4	1 quart	July 20
Atlacide buffered 0.45# per gallon	5	1 quart	July 20
Atlacide 2.7# per gallon	**	1.25 gallons	August 6
Ammonium thiocyanate 2# per gallon	***	0.75 gallons	August 20

*Seedling plot sprays.
** On plot outside experimental area in Mr. George Irwin's pasture.
***On plot outside and east of north end of experimental area.

Annual Report 1931
G. R. Van Atta

TABLE NO. 21

SUMMARY OF EXPERIMENTAL TREATMENTS APPLIED TO INDIVIDUAL BUSHES AT PENNSYLVANIA FURNACE IN 1931

Bush No.	Plot No.	Chemical Used and Concentration	Method of Application	Volume of Chemical Used in c.c.	Feet of Live Stem Treated	Approx. Weight in Grams of Chemical Per 100 Ft. of Live Stem	Date of Application
14	B1	Acetochloramide 10% + Dioxan 90%	2	50	375	2	July 8
15	B1	Acetochloramide 20% + Dioxan 80%	2	50	175	5	July 8
16	B1	Acetochloramide 20% + Dioxan 80%	2	50	350	3	July 8
17	B1	Acetochloramide 20% + Dioxan 80%	2	50	225	4	July 8
18	C1	Acetochloramide 20% + Dioxan 40% + Water 40%	2	75	475	3	July 8
*183	Outside area	Acetochloramide 5% + Water 95%	2	280	No Record	No Record	August 1
34	B1	Acetochloramide 20% + Water 80%	2	25	75	5	July 14
42	C2	Ammonium thiocyanate 10%	2	75	150	5	July 14
36	C3	do	2	100	350	3	July 14
*45	C5	do	2	125	250	5	July 14
51	C4	do	2	125	250	5	July 14
55	C5	do	2	190	375	5	July 15
59	C5	do	2	75	150	5	July 15
86	B5	do	2	40	400	1	July 25
91	B6	do	2	45	650	0.75	July 25
95	B6	do	2	91	750	1	July 25
98	B7	do	2	50	100	5	July 25
103	B7	do	2	51	300	2	July 25
33	C1	Ammonium thiocyanate 25%	2	25	125	5	July 10

*Denotes bush dug up for examination at end of season. Number of asterisks indicates number of plants examined in each instance.

TABLE NO. 21 (CONTINUED)

Bush No.	Plot No.	Chemical Used and Concentration	Method of Application	Volume of Chemical Used in c.c.	Feet of Live Stem Treated	Approx. Weight in Grams of Chemical Per 100 Ft. of Live Stem	Date of Application
35	C3	Ammonium thiocyanate 25%	2	55	300	5	July 14
41	C2	do	2	34	125	5	July 14
*46	C5	do	2	100	500	5	July 14
50	C4	do	2	110	550	5	July 14
54	C5	do	2	80	400	5	July 15
58	C5	do	2	58	300	5	July 15
87	B5	do	2	45	450	2.5	July 23
90	B6	do	2	280	1,400	5	July 25
94	C6	do	2	100	500	5	July 25
99	B7	do	2	100	500	5	July 25
102	B7	do	2	38	200	5	July 25
120	Outside area	do	2	240	1,200	5	July 29
*121	do	do	2	85	425	5	July 29
122	do	do	2	70	600	5	July 29
*123	do	do	2	70	350	5	July 29
*124	do	do	2	40	200	5	July 29
73	A15	Ammonium thiocyanate 30%	4	725	500	46	July 15
83	B21	Ammonium thiocyanate Saturated Solution	4	1,180	1,600	40	July 23
84	B22	do	4	708	900	45	July 23
104	B25	Ammonium thiocyanate 40%	5	7,568	6,800	45	July 25
408-409	B21	do	5	16,056	3,500	190	August 25
520	B18	do	6	2,554	1,000	100	August 31
521	C18	do	6	3,406	1,800	75	August 31
522	B18	do	6	3,595	1,900	75	August 31
523	C18	do	6	4,257	2,300	75	August 31
82	C20	Ammonium thiocyanate 30%	7	236	1,900	4	July 23
71	B18	Ammonium thiocyanate 40%	7	90	550	7	July 15
72	B18	do	7	90	650	6	July 15

*Denotes bush dug up for examination at end of season. Number of asterisks indicates number of plants examined in each instance.

TABLE NO. 21 (CONTINUED)

Bush No.	Plot No.	Chemical Used and Concentration	Method of Application	Volume of Chemical Used in c.c.	Feet of Live Stem Treated	Approx. Weight in Grams of Chemical Per 100 Ft. of Live Stem	Date of Application
*125	Outside area	Ammonium thiocyanate 40%	7	170	No Record	No Record	July 29
126	do	do	7	300	No Record	No Record	July 30
81	C21	Ammonium thiocyanate Saturated Solution	7	354	2,100	10	July 23
74	A19	Ammonium thiocyanate	8	400 gms	400	100	July 15
80	A20	Ammonium thiocyanate 5%	10	4,000	Several Bushes	No Record	July 23
24	B1	Atlacide 10%	2	150	450	3	July 9
26	B1	do	2	50	150	3	July 9
40	C3	Atlacide 10%	2	275	550	5	July 14
48	C5	do	2	50	100	5	July 14
22	B1	Atlacide 25%	2	60	400	4	July 9
23	B1	do	2	40	200	5	July 9
25	B1	do	2	20	100	5	July 9
39	C2	do	2	18	600	0.75	July 14
47	C4	do	2	50	250	5	July 14
66	A17	Atlacide 30%	4	1,000	600	45	July 15
163-172	A17	Atlacide 40%	5	7,568	3,200	100	July 31
173	A18	do	5	2,460	2,000	50	July 31
64	B17	Atlacide 30%	7	30	225	4	July 15
65	B17	do	7	30	225	4	July 15
68	A15	Atlacide solid	8	600 gms	600	100	July 15
79	C23	Atlacide 5%	10	6,000	Large Bush	No Record	July 23
78	B23	Atlacide 10%	10	5,000	do	No Record	July 23
282-283	B10	Chlorhydrine 20%	3	319	600	10	August 8
280-281	B12 B10	Chlorhydrine 40%	3	246	950	10	August 12
315	B22	do	3	565	2,200	10	August 13

*Denotes bush dug up for examination at end of season. Number of asterisks indicates number of plants examined in each instance.

TABLE NO. 21 (CONTINUED)

Bush No.	Plot No.	Chemical Used and Concentration	Method of Application	Volume of Chemical Used in c.c.	Feet of Live Stem Treated	Approx. Weight in Grams of Chemical Per 100 Ft. of Live Stem	Date of Application
317-323	C16	Chlorhydrine 40%	3	435	1,575	11	August 13
325-327	C16	do	3	416	1,600	10	August 13
339-340	C20	do	3	166	650	10	July 14
514-519	B22 C20	do	3	440	1,575	11	July 31
539-547	C20	do	3	635	2,400	10	Sept. 2
586-587	C17	do	3	330	1,250	10	Sept. 3
1-13	B101	Copper complex	1	No Record	No Record	No Record	June 19
2P	C11	Copper complex 10%	2	100	300	3	June 2
*3P	C11	do	2	90	225	5	June 2
8P	No Record	Copper complex 10%	2	50	No Record	No Record	June 30
*9P	do	do	2	50	225	2	June 30
*10P	do	do	2	55	350	2	June 30
27	B1	do	2	100	200	5	July 9
30	C1	do	2	50	100	5	July 9
38	C2	do	2	150	300	5	July 14
43	C5	do	2	100	200	5	July 14
52	C4	do	2	300	600	5	July 14
57	C5	do	2	175	350	5	July 15
61	C5	do	2	275	550	5	July 15
89	B6	do	2	67	300	2	July 25
93	B6	do	2	78	600	1	July 25
97	B7	do	2	50	100	5	July 25
100	B7	do	2	150	300	5	July 25
*4P	C12	Copper complex 20%	2	54	200	5	June 2
28	B1	Copper complex 25%	2	50	250	5	July 9
29	C1	do	2	60	300	5	July 9
37	C2	do	2	100	500	5	July 14

*Denotes bush dug up for examination at end of season. Number of asterisks indicates number of plants examined in each instance.

TABLE NO. 21 (CONTINUED)

Bush No.	Plot No.	Chemical Used and Concentration	Method of Application	Volume of Chemical Used in c.c	Feet of Live Stem Treated	Approx. Weight in Grams of Chemical Per 100 ft. of Live Stem	Date of Application
44	C4	Copper complex 25%	2	50	250	5	July 14
49	C3	do	2	150	750	5	July 14
56	C5	do	2	45	225	5	July 15
60	C5	do	2	60	300	5	July 15
88	C6	do	2	140	700	5	July 25
92	B6	do	2	80	400	5	July 25
96	B7	do	2	80	300	7	July 25
101	B7	do	2	60	300	5	July 25
108*	Outside area	Copper complex 35%	2	50	350	5	July 29
109	do	do	2	68	500	5	July 29
110	do	do	2	214	1,500	5	July 29
111	do	do	2	36	250	5	July 29
112	do	do	2	25	175	5	July 29
113*	do	do	2	19	140	5	July 29
114	do	do	2	71	500	5	July 29
115*	do	do	2	300	2,100	5	July 29
116	do	do	2	64	450	5	July 29
117*	do	do	2	110	775	5	July 29
118*	do	do	2	92	650	5	July 29
119	Outside area	Copper complex 35%	2	115	800	5	July 29
127	do	do	2	43	No Record	No Record	July 30
186	do	do	2	119	do	do	August 1
223	B12	do	3	58	200	10	August 5
224	B12	do	3	29	100	10	August 5
6P*	C13	Copper complex 40%	2	25	250	4	June 2
202	C16	Copper complex 35%	3	720	4,800	5	August 3
203	C11	do	3	160	600	9	August 3
204	B12	do	3	190	700	9	August 3
219	B12	do	3	315 7 tubes	1,200	9	August 5
220	B12	do	3	86 2 tubes	300	10	August 5
221	B12	do	3	172 4 tubes	600	10	August 5

*Denotes bush dug up for examination at end of season. Number of asterisks indicates number of plants examined in each instance.

TABLE NO. 21 (CONTINUED)

Bush No.	Plot No.	Chemical Used and Concentration	Method of Application	Volume of Chemical Used in c.c.	Feet of Live Stem Treated	Approx. Weight in Grams of Chemical Per 100 Ft. of Live Stem	Date of Application
222	B11	Copper complex 35%	3	143 3 tubes	500	10	August 5
228	B11	do	3	135	600	8	August 5
229	B12	do	3	185	800	8	August 5
230-237	B11 C11	do	3	685	2,600	9	August 6
239-244	C10	do	3	628	1,600	10	August 6
245* 247*	C10	do	3	173	600	10	August 7
253	C10	do	3	82	300	10	August 7
255-259	B9 B10	do	3	391	1,375	10	August 8
260* 270*	B9 B10	do	3	751	2,575	10	August 10
284-292	B10	do	3	442	1,545	10	August 12
294-307	B10	do	3	857	2,485	10	August 12
316	C16	do	3	60	200	10	August 13
324	C16	do	3	33	125	10	August 13
328-333	B24 C19 C24	do	3	1,505	5,675	9	August 14
343-352	B7 B8	do	3	1,213	4,120	10	August 14
354-367	A7 A8 B6 B7 B8	do	3	1,260	4,475	10	August 14
369	B6	do	3	43	150	10	August 20
372-391	B3 B4 B5 B6 C3 C4 C5	do	3	1,752	6,145	10	August 20

*Denotes bush dug up for examination at end of season. Number of asterisks indicates number of plants examined in each instance.

TABLE NO. 21 (CONTINUED)

Bush No.	Plot No.	Chemical Used and Concentration	Method of Application	Volume of Chemical Used in c.c.	Feet of Live Stem Treated	Approx. Weight in Grams of chemical Per 100 Ft. of Live Stem	Date of Application
392	Creek Bank	Copper complex 35%	3	100	350	10	August 21
395	C3	do	3	257	900	10	August 21
410-431	B1 B2 B3 B6 C2	do	3	2,073	7,275	10	August 25
432-447	B12 C11 C12	do	3	2,213	7,585	12	August 26
448-468	B12 B13 C12 C13	do	3	2,152	7,275	10	August 27
529-532	C20	do	3	236	800	10	Sept 1
537	C21	do	3	455	1,600	10	Sept. 2
238	C10	Copper complex 40%	3	150	600	10	August 6
248-252	C10	do	3	263	1,050	10	August 7
254	B9	do	3	50	200	10	August 7
368	B6	do	3	75	300	10	August 14
393	Creek Bank	do	3	56	225	10	August 21
394	do	do	3	174	700	10	August 21
396	B3	do	3	146	550	10	August 21
469-489	B11 B12 C11	do	3	2,340	9,410	10	August 28
490	Opp. C6 on Creek bank	Copper complex 40%	3	29	125	10	August 28

*Denotes bush dug up for examination at end of season. Number of asterisks indicates number of plants examined in each instance.

TABLE NO. 21 (CONTINUED)

Bush No.	Plot No.	Chemical Used and Concentration	Method of Application	Volume of Chemical Used in c.c.	Feet of Live Stem Treated	Approx. Weight in Grams of Chemical Per 100 Ft. of Live Stem	Date of Application
492-507	B22 B23 B24 C23	Copper complex 40%	3	3,997	15,710	10	August 29
508-513	B22 B23	do	3	444	1,710	10	August 31
524-528	B22	do	3	1,005	3,850	10	Sept. 1
533-536	B22 C21	do	3	1,620	6,400	10	Sept. 2
538	C20	do	3	110	450	10	Sept. 2
548-585	B19 C17 C18 C19 C20	do	3	2,035	7,950	10	Sept. 3
63	A18	do	4	500	175	100	July 14
85	B26	do	5	4,730	3,700	50	July 24
588	B25	do	6	2,600	1,600	65	Sept. 3
11P	B17	do	7	173	2,400	3	June 30
67	A18	Copper complex	8	1,355 gms.	1,300	100	July 15
184	Outside area	Dioxan 10%	2	80	No Record	No Record	August 1
185	do	Dioxan 25%	2	67	do	do	August 1
20	C1	Dioxan 50%	2	25	110	25	July 8
19	C1	Dioxan	2	25	75	35	July 8
21	C1	duPont 5%	2	100	200	2.5	July 8
53	C4	do	2	186	400	2	July 14
176	C18	do	2	150	435	1.5	July 31
177	do	do	2	155	315	2.5	July 31
178	do	do	2	165	300	2.5	July 31
179	do	do	2	265	475	2.75	July 31
70	A16	do	4	2,500	225	50	July 15
180	C18	do	7	120	800	0.75	July 31
181	do	do	7	110	600	1	July 31
62	B17	duPont	8	680 gms.	300	200	July 15

TABLE NO. 21 (CONTINUED)

Bush No.	Plot No.	Chemical Used and Concentration	Method of Application	Volume of Chemical Used in c.c.	Feet of Live Stem Treated	Approx. Weight in Grams of Chemical Per 100 Ft. of Live Stem	Date of Application
69	B18	duPont 5%	10	500	350	7	July 15
341-342	B8	duPont	8	800 gms.	950	8	August 14
205-218	B22	Ethylene oxide	9	2,600	9,728	27	August 4
225	B18	do	9	975	2,800	35	August 5
274-276	Outside area	do	9	2,325	2,400	100	August 11
182	C19	Propylene oxide 12½%	2	100	250	5	July 31
76	C18	Propylene oxide 25%	2	40	150	7	July 23
174	B18	do	2	137	400	8	July 31
175	C18	do	2	113	350	8	July 31
75	do	Propylene oxide	2	8	125	6	July 23
77	C19	do	9	150	500	30	July 23
370	B18	Sodium chloride	8	50 lb.	1,800	1,258	July 17
371	do	do	8	15 lb.	250	2,718	July 17
372	B19	do	8	10 lb.	150	3,020	July 17
407	B14	Sodium hydroxide 2%	2	4	250	No Record	August 21
139	Outside area	Sulform 50%	2	20	No Record	No Record	July 30
141	do	do	2	40	do	do	July 30
137	do	do	2	20	do	do	July 30
32	C1	Sulform	2	50	400	15	July 10
138	Outside area	do	2	15	No Record	No Record	July 30
140	do	do	2	20	do	do	July 30
145-148	A17	do	4	775	850	100	July 31

TABLE NO. 21 (CONTINUED)

Bush No.	Plot No.	Chemical Used and Concentration	Method of Application	Volume of Chemical Used in c.c.	Feet of Live Stem Treated	Approx. Weight in Grams of Chemical Per 100 Ft. of Live Stem	Date of Application
143	Outside area	Sulform	7	No Record	No Record	No Record	July 30
31	B1	do	9	250	600	50	July 10
142	Outside area	Sulform 25%	10	No Record	No Record	No Record	July 30
144	do	Sulform	10	do	do	do	July 30
128-136	C22	Sulphur dioxide	9	do	Large Bushes	do	July 30
226-227	B18 B19	do	9	do	1,500	do	August 5
277-279	Outside area	do	9	do	2,000	do	August 11
293	do	do	9	do	650	do	August 12
308-314	do	do	9	do	1,005	do	August 12
1P*	C11	Zinc ammonium chloride 10%	2	100	225	5	June 2
5P	C12	Zinc ammonium chloride 20%	2	50	200	5	June 2
7P	C13	Zinc ammonium chloride 40%	2	25	200	5	June 2
152-162	A16 A17	do	5	7,568	2,400	125	July 31
397-406	A17 A19 B14 B21 B22	do	5	16,987	4,600	145	August 21
149-151	A15	Zinc ammonium chloride	8	1,100 gms.	1,000	100	July 31

*Denotes bush dug up for examination at end of season. Number of asterisks indicates number of plants examined in each instance.

The study of those methods by which solutions of toxic chemicals are applied to plants through severed stems or roots has assumed considerable practical importance. Some experiments planned to assist this study are reported in Table No. 22. The experimental procedure employed in these tests was as follows:

A vigorously growing stem was cut from the bush to be treated at a point from 3 to 4 inches above the surface of the soil. A glass tube was affixed in an upright position to the end of the stump by means of a joint made by a short length of tightly fitting rubber tubing. The glass tube was then filled with a known quantity of the solution undergoing test. At the end of the period of the experiment the volume of solution still remaining in the tube was measured and deducted from the volume originally present. The rate of absorption in cubic centimeters per hour was computed from the difference of the measured volumes and the time during which this quantity of solution was absorbed by the plant.

TABLE NO. 22

COMPARISON OF RATES AT WHICH SOLUTIONS OF AMMONIUM THIOCYANATE, COPPER COMPLEX, AND ZINC AMMONIUM CHLORIDE ARE ABSORBED THROUGH SEVERED BARBERRY STEMS

Date of Application	Chemical Used	Concentration in Per Cent	Height of Bush in Feet	Feet of Live Stem	Rate of Absorption in c.c. Per Hour	Chemical Used	Concentration in Per Cent	Height of Bush in Feet	Feet of Live Stem	Rate of Absorption in c.c. Per Hour
July 2	Copper complex	10	6	300	73.0	Zinc ammonium chloride	10	6	225	84.9
do	do	20	5	300	129.6	do	20	5	200	41.5
do	do	20	5	200	67.5					
do	do	40	5	250	75.0	Zinc ammonium chloride	40	6	200	27.3
July 27	do	20	7	1,300	22.3	Ammonium thiocyanate	20	7	1,300	3.2
do	do	20	7	1,300	9.6	do	20	7	1,000	3.3
do	do	25	7	1,500	70.0					
do	do	30	7	1,300	4.4	Ammonium thiocyanate	30	7	1,300	2.6
do	do	30	7	1,300	34.3	do	30	7	1,000	2.4
do	do	35	7	1,300	10.8	do	35	7	1,300	2.0
do	do	35	7	1,300	30.0					
do	do	40	7	1,500	25.7	Ammonium thiocyanate	40	7	1,000	3.3
July 28	do	20	5	500	60.0	do	20	5	500	4.0
July 28						do	20	5	500	3.9
do	Copper complex	30	5	500	25.0	do	30	5	500	4.0
do	do	40	5	500	27.0	do	40	5	500	2.2
do						do	40	5	500	2.9

Table No. 23 is a record of some preliminary tests that were undertaken for the purpose of ascertaining how long toxic chemicals that have been applied to the soil as herbicides may be expected to prevent growth of plants on the soil that has received the treatment. Each of the solutions listed in the table were applied to the surface of the ground over an area corresponding to a circle one foot in diameter. On August 11, which was ten days after the applications were made, beans were planted in all the small plots treated on August 1. Three rains had fallen upon the plots between these two dates. The beans germinated well and put out their first leaves, but wilted and died shortly thereafter. Beans will again be planted in the plots in the summer of 1932.

Very much more extensive experiments have been planned for the purpose of continuing the study of this subject. Some of these experiments are at present in progress in the laboratories.

TABLE NO. 23

SUMMARY OF EXPERIMENTAL APPLICATIONS OF TOXIC CHEMICALS TO SOIL PERFORMED AT MAUMEE IN 1931 TO TEST THE PERSISTENCE OF HERBICIDAL EFFECTS IN THE SOIL

Plot Number	Chemical and Concentration	Volume Used in Quarts	Exposure and Soil Type	Date of Application
187	Ammonium thiocyanate 40%	1/3	Full sun. Sandy soil.	August 1
188	do	2/3	do	do
189	do	1	do	do
190	Zinc ammonium chloride 40%	1/3	do	do
191	do	2/3	do	do
192	do	1	do	do
202L	Atlacide 40%	1/3	do	do
203L	do	2/3	do	do
204L	do	1	do	do
353	Copper complex 40%	1/3	do	August 17
193	Ammonium thiocyanate 40%	1/3	Mostly shade. Sandy loam	August 1
194	do	2/3	do	do
195	do	1	do	do
196	Zinc ammonium chloride 40%	1/3	do	do
197	do	2/3	do	do
198	do	1	do	do
199	Atlacide 40%	1/3	do	do
200	do	2/3	do	do
201	do	1	do	do

A grassy sod covered the area in full sun prior to treatment. The sod was removed from the surface of the plots which were each about one foot in diameter. The soil was mulched and the solution was poured evenly over the surface. The plots in the shade were under a group of pine and oak trees. No vegetation was growing on the plots prior to the treatment. These plots were of the same size as those in the sun. The surface soil was mulched before the chemical was applied.

Colorado: E. A. Lundgren, State Leader for the Division of Barberry Eradication in Colorado, performed the series of experiments reported in Table No. 24 at the request of Doctor F. C. Meier. The method of application used in these experiments was the same one that was employed in the experiments reported in Table No. 21.

TABLE NO. 24

SUMMARY OF EXPERIMENTAL TREATMENTS APPLIED TO INDIVIDUAL BUSHES IN COLORADO DURING 1931

Bush No.	Chemical and Concentration	Volume of Solution Used in c.c.	Feet of Live Stem Treated	Approximate Weight in Grams of Chemical Per 100 Ft. of Live Stem	Date of Application
		Pueblo County			
1	Copper complex 35%	60	150	13	August 18
2	do	300	650	15	August 18
3	do	30	50	20	August 18
4	do	500	1,200	15	August 22
		Fremont County			
2	Copper complex 30%	130	175	23	August 19
3	do	60	110	18	August 19
7	do	50	60	25	August 19
8	do	60	100	20	August 19
10	do	60	50	40	August 19
11	do	60	90	22	August 19

D. Late Season Observations on Field Experiments

At the close of the field season, the plants concerned in the various experiments were inspected for the purpose of roughly gauging the effectiveness of the treatments that had been applied. Past experience with other plant species has shown the folly of attempting to interpret the results of late season checks too closely. For this reason only the broadest general conclusions concerning the effectiveness of the experimental treatments applied during 1931 can be given at this time.

It is fairly evident from the results of the late season check that ammonium thiocyanate is quite toxic to barberry. The question of whether or not it will be possible to take full advantage of this fact in practice cannot be answered on the basis of the information now available.

None of the other chemicals that were applied to this work for the first time during 1931 appear to offer any advantages over those that were previously used.

It is impossible at this time to evaluate the various methods of chemical application upon the basis of the experiments performed in 1931.

E. Tentative Recommendations for the Application of Chlorate Sprays to Barberry

A comprehensive study of the results obtained from the investigative work to date permits the formulation of the following recommendations for eradication of barberry by the application of aqueous chlorate sprays containing either sodium chlorate or sodium chlorate-calcium chloride mixtures. If sodium chlorate is used alone the spray solution should be made by dissolving 0.89 pounds of the chemical in each gallon of water. If it is desired to use the commercial weed-killing preparation sold under the name of Atlacide, which is composed of sodium chlorate and calcium chloride in the proportion of two molecular weights of the former to one molecular weight of the latter, 1.45 pounds of the chemical should be dissolved in each gallon of water that is to be used as spray.

It is necessary to add some substance to the solution that will counteract the tendency on the part of the spray to speedily drain from plant surfaces after application. Such a substance is called a spreader. Animal glue has been found to be a satisfactory spreader for chlorate sprays. It should be used in a quantity corresponding to approximately 0.01 per cent of the weight of the spray solution. It is convenient to make up a stock solution of glue which may be added in small quantity to each batch of spray. The stock solution is prepared by soaking one-half pound of dry animal glue in cold water for several hours after which the mixture should be heated and stirred until the glue is completely melted. Cold water should then be added in sufficient quantity to bring the total volume to three gallons. Eight ounces of this prepared glue should be added to each ten gallons of spray solution after the chemical has been dissolved.

The spray should be evenly applied to all the surfaces of the aerial parts of the plants. In addition to completely covering the aerial portions, spray solution should be applied to the bases of the stems and the soil immediately surrounding them. The total quantity of spray solution used should be not less than two-thirds of a gallon per 100 feet of live stem. This volume of sodium chlorate solution prepared according to the foregoing specifications is roughly equivalent to 6/10ths of a pound of chemical. If Atlacide is used according to the directions given, approximately one pound of chemical will be applied per 100 feet of live stem. Any sprayer capable of performing the work may be used. A type of hand-operated sprayer has been developed by the Division of Blister Rust Control that is eminently suited for this work. This sprayer is equipped with a "knapsack" tank capable of holding approximately 5 gallons of spray solution. The tank is mounted on a pack board so that it may be

conveniently carried by the workman. The pump is double acting and of the trombone type. These sprayers may be purchased from commercial firms dealing in this kind of equipment. Attention is called to the fact that, while the foregoing recommendations are based upon fairly conclusive data and experience, further work will undoubtedly result in the development of more perfect specifications for the use of chlorate sprays upon barberry.

The investigative program is yet too young to permit the formulation of even tentative plans for the practical application of any other herbicides than chlorates. Neither is it possible at this time to offer any definite recommendations for the use of any of the newer methods of application.

PART III

OUTLINE OF INVESTIGATIVE WORK
PROJECT 2,3-1, FOR PERIOD SEPTEMBER, 1931 - MAY, 1932

Personnel

Supervision - - - - H. R. Offord, Agent.
Acting in Charge - G. R. Van Atta, Agent.

Chemical work - - - G. R. Van Atta, Agent, R. P. d'Urbal, Assistant Chemist; G. E. Draper, Agent; L. S Keyser, Agent; R. W. Vance, Agent; and J. Vogtmann, Agent.

Morphological - - - C. R. Quick, Junior Microanalyst.

Physiological - - - R. P. d'Urbal at Moscow, Idaho; G. R. Van Atta at Berkeley, California

Division of Work

The chemical work is to be divided between two experimental stations at Berkeley, California, and Moscow, Idaho. The morphological work is to be undertaken at Berkeley. Physiological experiments necessary to the conduct of the investigative program will be performed at Berkeley and Moscow.

Assignments

Offord and or Van Atta

(1) General supervision.
(2) Preparation of annual report.
(3) Analysis of physiological data obtained in the field and laboratory bearing upon the movement and distribution of foreign substances after they have been introduced into the bodies of plants.
(4) Determination of structure and dissociation constants for copper complex.
(5) Preparation of special report upon factors concerned in the promotion of spontaneous ignition of organic material in contact with chlorates.
(6) Preparation of special report listing all experimental methods and chemicals used in investigative work from 1923 to the present date. Result obtained in each case will be briefly summarized.

d'Urbal:

(1) Supervision of all work undertaken at Moscow.
(2) Greenhouse propagation of Ribes and barberries at Moscow.
(3) Determination of fixative and alterative properties of forest soils.

Soil samples under various conditions of temperature and moisture will be treated with varying known amounts of chemicals for varying lengths of time. Solutions obtained from these samples by lixiviation will be examined analytically to ascertain the fate of and rate of destruction or disappearance of various chemicals used under the conditions of the experiments. The list of chemicals used shall include sodium chlorate, copper complex, copper sulphate, ammonium thiocyanate, ammonium chloride, and sodium chloride.

(4) Experiments with solutions obtained by maceration of frozen Ribes and barberry material.

These experiments will be conducted with a view to obtaining a key to the action of toxic materials upon plant substances. Particular attention will be paid to reactions resulting upon admixture of certain chemicals with the solutions. The list of chemicals to be used in this connection will include sodium chlorate, copper complex, ammonium thiocyanate, copper sulphate, ammonium chloride, and others. Analyses of the material for protein and non-protein nitrogen will be made before and after treatment. Any precipitates formed in the treatment will be examined analytically. The detailed course of this investigation is to be determined in large measure by the findings obtained as the work progresses.

Draper and Keyser:

(1) Routine analytical work at Moscow at the discretion of d'Urbal.
(2) Proximate analyses of Ribes and barberry in completion of work started in 1930.
(3) Analysis of forest soil solutions obtained from samples collected in California and Idaho.

Vance and Vogtmann:

(1) Routine analytical work at Berkeley at discretion of Van Atta.
(2) Greenhouse propagation of Ribes and barberry at Berkeley.
(3) Preparation of displaced forest soil solutions for analysis at Moscow.
(4) Analysis of Ribes samples collected during 1931 field season for study of movement and distribution of foreign substances after they have been introduced into bodies of plants.

Quick:

(1) In immediate charge of morphological laboratory at Berkeley.
(2) Preparation of special report summarizing the morphological work performed to date, particular attention being given to the relation of this work to the practical problems of chemical eradication.
(3) Continuation of the morphological investigations in accordance with the following plan:

Histological differences between woody parts of actively growing plants and plants entering dormancy.

This study is to be an attempt to discover the morphological explanation, if such exists, for the observed fact that actively growing plants take up much greater quantitites of solutions through cut stems than do plants entering dormancy. The specimens to be used will consist of stems, leaves, and petioles from plants in both conditions taken from the three principal California species.

Wood of roots and stems.

Comparison of wood structures of R. roezli, R. nevadense, and R. cereum, and an attempt at correlation with findings obtained in above topic. Specimens from vigorous and actively growing plants will be used for this work.

Leaf structure.

Statistical study of the structures of leaves of R. roezli, R. nevadense, and R. cereum to ascertain the range of variation from the characteristic mean for each species. The features to be examined will include palisade ratio, epidermal thickness, and frequency of stomata, glands, hairs, hydathodes, etc. Ecological factors will be considered in formulation of conclusions. This study is in continuation of work begun in 1930.

Effect of toxic substances upon meristematic tissues.

Histological examination to be made of material collected in field (1931) from treated and untreated plants to ascertain the character of injury, if any, done to the cambium, etc., by various chemicals applied in several ways. R. roezli is the only plant to be used in this study.

Structures of less important California Ribes.

General preliminary comparative survey of the structures of R. montigenum, R. lasianthum, R. inerme, R. aureum, R. velutinum, R. glutinosum, R. leptosmum.

Bud scales.

Determination and comparison of the structures comprising the bud scales which form at the beginning of dormancy and persist until the next growing season.

(4) In immediate charge of propagation of Ribes in Ribes garden established in Strawberry Canyon at Berkeley.

STUDIES IN EFFECTIVENESS OF CONTROL, 1931

By
E. L. Joy
Junior Forester

The general purpose of studies by this project is to determine the effectiveness of Ribes suppression in pine protection. With this purpose in mind two types of studies are being conducted which are: (1) the growth and regeneration of Ribes following eradication and, (2) the effect of known amounts of Ribes per acre in spreading and intensifying blister rust.

For the purpcse of studying the growth and regeneration of Ribes following eradicatinn, 247 stream type plots have been established and examined annually. The effect of known amounts of Ribes per acre in spreading and intensifying blister rust has been studied by surveys of pine infection centers. Additional data on this point will be secured from white pine plantations established on areas where Ribes eradication has been performed and pine infection has invaded. In 1930 and 1931 weather data were secured for the purpose of correlating weather conditions, particularly relative humidity, with intensity of infection.

The progress of the work of this project is given in the following reports:

Checking for Ribes on eradication areas in Idaho after Ribes eradication 1931.

Pine infection surveys in Idaho, 1931.

White pine plantations established, 1931.

Progress report on the Newman Lake infection study, Newman Lake, Washington, 1931.

CHECKING FOR RIBES ON ERADICATION AREAS IN IDAHO AFTER RIBES ERADICATION 1931

By
H. N. Putnam, Associate Pathologist
E. L. Joy, Junior Forester

INTRODUCTION

Checking for Ribes in 1931 was confined to (1) establishment of new permanent check plots before initial Ribes eradication in 1931; (2) examination of permanent check plots established in 1929 and 1930; and (3) checking by temporary plots areas where Ribes eradication was performed in 1930 and 1931. Experience in the past has repeatedly demonstrated the human impossibility of removing all of the Ribes at one working. It was decided in the winter of 1930-1931 that until further study gives a more reliable figure, 50 feet of Ribes live stem per acre would arbitrarily constitute a maximum amount allowable in determining if sufficient protection against blister rust had been afforded the pines on an area.

PURPOSE

The purpose of checking is to determine in a quantitative manner, (1) the Ribes left after eradication, and (2) the effect of control efforts upon the Ribes population. Part 2 involves a careful and continued study of the growth and regeneration of Ribes in order to determine the best time to perform subsequent workings.

DESCRIPTION OF PLOTS

Both permanent and temporary check plots are .2 of a chain (13.2 feet) wide. In stream type these plots are established at right angles to the stream course and are as long as the type width. In upland type the plot length is determined by the limits of Ribes eradication or of that portion of an area designated for check.

The distance between plots varies according to the intensity of checking. All permanent plots, which are established primarily to study the effect of stream type Ribes eradication on areas supporting R. petiolare, are spaced at intervals of 20 chains and represent a 1 per cent sample. Temporary plots are established at intervals of 10 or 5 chains thereby giving a 2 or 4 per cent check. In addition to being more intensive, temporary checking is extended to include the bulk of the area. The results of temporary checking in stream type are therefore more representative of the conditions on the entire area than are the results from the permanent plots.

To facilitate plot examination and for simplicity in conversion to the acre basis, the milacre (1/1,000 acre) unit is used. This unit, which as used is a 6.6 foot square, is of most value in connection with the permanent plots which are examined each year.

CHECKING IN 1931

Checking was performed on Ribes eradication areas in the Potlatch and Clearwater timber protective associations and the Clearwater National Forest. No checking was done on areas worked in 1931 on the Coeur d'Alene or Priest Lake timber protective associations. The amount of checking in 1931 is shown in Table No. 1

TABLE NO. 1

PERMANENT AND TEMPORARY CHECK PLOTS EXAMINED IN 1931

Forest Unit	Year Permanent Plots Established									Temporary Plots 1931		
	1929		1930		1931		All Years					
	No. Plots	No. Mil-acres	No. Plots	No. Mil-acres	No. Plots	No. Mil-acres	No. Plots	No. Mil-acres	No. Acres Checked	No. Plots	No. Mil-acres	No. Acres Checked
Potlatch Timber Protective Association	46	1,142	45	1,650	19	886	110	3,678	367.8	395	48,008	2,400.4
Clearwater Timber Protective Association	129	4,048	0	0	8	610	137	4,658	465.8	1,108	17,902	895.1
Clearwater National Forest	0	0	0	0	0	0	0	0	0.0	284	9,088	454.4
Total	175	5,190	45	1,650	27	1,496	247	8,336	833.6	1,787	74,998	3,749.9

In the total of 4,583.5 acres checked as shown in Table No. 1, is included 6 areas on which both permanent and temporary checking was performed and two areas where permanent plots were established in 1931 but not checked because of incomplete Ribes eradication. By making deductions for these areas the checking data apply to 4,072.5 acres.

All examinations of permanent plots established in 1929 and 1930 were made prior to any additional eradication of Ribes from these areas in order to ascertain the Ribes conditions one and two years after the initial work. For the first time all permanent plots established in 1929 and 1930 were examined in 1931 excepting two on Gold Creek in the Potlatch Timber Protective Association which have been abandoned.

RESULTS OF CHECKING

The results of checking in 1931 are discussed according to the three forest units on which the work was done. For each unit the results of checking by permanent plots is discussed first, followed by a discussion of the results of checking by temporary plots.

A. Checking on the Potlatch Timber Protective Association Lands

1. Permanent plots. In Table No. 2 there are shown the results of checking by permanent plots on the Potlatch Timber Protective Association lands.

TABLE NO. 2

FEET OF LIVE STEM PER ACRE OF ALL RIBES SPECIES BEFORE AND AFTER ERADICATION, POTLATCH TIMBER PROTECTIVE ASSOCIATION, ONE PER CENT CHECK BY PERMANENT PLOTS

Drainage	Year of Eradication	Before Eradication		After Eradication					
				Same Year as Eradication		1 Year After		2 Years After	
		Acres Checked	Feet Live Stem Per Acre	Acres Checked	Feet Live Stem Per Acre	Acres Checked	Feet Live Stem Per Acre	Acres Checked	Feet Live Stem Per Acre
East Fork Potlatch Creek	1929	27.6	114,007	Not checked.		27.6	740	27.6	745
Mallory Creek	1929	35.0	56,489	20.4	794	20.4	1,024	35.0	1,162
Deep Creek	1929	51.6	13,561	39.2	327	39.2	471	51.6	377
Total or Average	1929	114.2	50,993	59.6	487	87.2	685	114.2	707
Johnson Creek	1930	49.6	35,734	49.6	1,680	49.6	2,004	-	-
Cameron Creek	1930	98.8	37,951	98.8	2,239	98.8	3,131	-	-
Shattuck Creek	1930	16.6	58,922	16.6	2,945	16.6	7,417	-	-
Total or Average	1930	165.0	39,395	165.0	2,142	165.0	3,223	-	-
Ruby Creek	1931	88.6	12,570	Not checked.*		-	-	-	-

*These plots were not reexamined in 1931 because a fire swept over most of the stream type sampled after the plots were established and before the eradication work was completed.

The Ribes amounts per acre after eradication on these areas are far in excess of the 50 feet of live stem per acre allowable.

On the three drainages worked in 1929 there is apparent a small but definite increase in live stem one or two years after eradication. This increase seemed to be greater during the first year than during the second year. On Deep Creek the reduction of 94 feet of live stem per acre between the first and second year after Ribes eradication may be due partly to the continued dying out of old stem surviving one year after eradication or to the difference in the number of milacres used. In 1931 there were 516 milacres checked as opposed to 392 in 1930.

There was a much larger amount of live stem left after the work done in 1930 than that done in 1929. On Johnson, Cameron and Shattuck creeks there were 2,142 feet of live stem left per acre, over four times the amount left in 1929 following the eradication work of that year. The probable explanation for this increased amount of live stem left on these creeks lies in the character of the Ribes growth. A large proportion of the R. petiolare here grew with its roots in water, making it impossible to completely kill these bushes by the application of spray to the aerial portions. This condition did not obtain to any great extent on the areas worked in 1929.

In Table No. 3 the data on which Table No. 2 is based have been analyzed according to the feet of live stem per acre by Ribes species.

TABLE NO. 3

FEET OF LIVE STEM PER ACRE OF EACH RIBES SPECIES AFTER ERADICATION, ALL DRAINAGES, POTLATCH TIMBER PROTECTIVE ASSOCIATION, ONE PER CENT CHECK BY PERMANENT PLOTS

Year of Eradication	Year Checked	Acres Checked	Feet Live Stem Per Acre After Eradication					
			R. pet.	R. lac.	R. inerme	R. vis.	R. irrig.	Total
	1929	59.6	120	359	8	0	0	487
	1930	87.2	266	393	26	0	0	685
1929	1931	114.2	196	440	59	0	12	707
	1930	165.0	1,738	169	235	0	0	2,142
1930	1931	165.0	2,369	223	629	2	0	3,223

For each Ribes species a definite increase in live stem per acre is apparent each year following eradication with one exception. R. petiolare between the first and second year following the 1929 eradication showed a decrease of seventy feet per acre.

The Ribes species most abundant after eradication on the areas worked in 1929 was R. lacustre while in 1930 it was R. petiolare. This fact emphasizes the statement that the habit of R. petiolare of growing with its roots in the water on the areas worked in 1930 was the factor chiefly responsible for its survival.

Ribes seedlings following eradication play an increasingly important part in repopulating an area with Ribes two or more years after eradication. In making a seedling count on permanent plots it is not presumed that every Ribes seedling present is seen and counted. Such a high degree of accuracy would make it impossible to adequately cover all the plots established. With a uniform and reasonably accurate determination of the number of seedlings on each plot, it is believed that the gross effect of the Ribes seedling factor will appear. In Table No. 4 the number of seedlings per acre are shown. The feet of live stem of these seedlings are not shown here, but are included in Tables Nos. 2 and 3.

TABLE NO. 4

NUMBER OF RIBES SEEDLINGS PER ACRE ORIGINATING AFTER ERADICATION, POTLATCH TIMBER PROTECTIVE ASSOCIATION, 1 PER CENT CHECK BY PERMANENT PLOTS

Drainage	Year of Eradication	Acres* Checked	Number of Seedlings Per Acre Found							
			One Year After Eradication				Two Years After Eradication			
			R. pet.	R. lac.	R. iner.	Total	R. pet.	R. lac.	R. iner.	Total
East Fork Potlatch Creek	1929	27.6 27.6	3,750	703	0	4,453	902	830	0	1,732
Mallory Creek	1929	20.4 35.0	1,490	377	0	1,867	260	20	0	280
Deep Creek	1929	39.2 51.6	23	43	0	66	2	4	0	6
Total or Average	1929	87.2 114.2	1,546	330	0	1,876	299	208	0	507
Johnson Creek	1930	49.6 49.6	214	2	38	254	-	-	-	-
Cameron Creek	1930	98.8 98.8	98	11	22	131	-	-	-	-
Shattuck Creek	1930	16.6 16.6	6	6	0	12	-	-	-	-
Total or Average	1930	165.0 165.0	124	8	25	157	-	-	-	-

*The first number refers to 1 year and the second to 2 years after eradication.

No Ribes seedlings were found which were definitely determined as originating the same year as the Ribes eradication. With the exception of R. lacustre on the East Fork of Potlatch Creek the largest number of Ribes seedlings per acre of each species was found in 1930, one year after the 1929 Ribes eradication. Apparently conditions that year were conducive to rapid germination of Ribes seed.

With the exception noted above, the Ribes seedling population decreased during the second year after Ribes eradication. Because all seedlings germinating after eradication are included in this count, and because many were found that originated the second year, it is evident that there is a high mortality of seedlings germinating the first year after Ribes eradication.

From Table No. 3 it was seen that there was a decrease of 70 feet in R. petiolare live stem per acre during the second year following the initial Ribes eradication. Table No. 4 shows that during this same year there was a decrease of 1,247 R. petiolare seedlings per acre. In 1931 the average size of all R. petiolare seedlings was not materially greater than in 1930. Therefore the reduction in feet of live stem shown in Table No. 3 is mostly chargeable to the reduction in feet of live stem of seedlings.

2. Temporary plots. The results of checking by temporary plots on lands of the Potlatch Timber Protective Association are shown in Table No. 5.

TABLE NO. 5

FEET OF LIVE STEM PER ACRE BY RIBES SPECIES AFTER ERADICATION, POTLATCH TIMBER PROTECTIVE ASSOCIATION 1931, 2 PER CENT CHECK BY TEMPORARY PLOTS

Area	Type	Year of Eradication	Acres Checked	Number of Milacres Checked	Feet Live Stem Per Acre by Ribes Species					
					R. pet.	R. lac.	R. iner.	R. vis.	R. irr.	Total
Long Meadow Infection Area	Stream and Upland	1929 1931	822.2	16,444	0	9	0	3	0	12
Deep and Elk Creeks Infection Area	Stream and Upland	1930 1931	1,167.1	23,342	Trace	2	0	6	21	29
Johnson Creek	Stream	1930 1931	134.7	2,694	48	305	32	2	0	387
Cameron Creek	Stream	do.	137.6	2,752	49	120	16	10	0	195
Shattuck Creek	Stream	do.	66.3	1,326	18	109	0	21	0	148
Bull Run Creek	Stream	do.	66.9	1,338	70	25	3	8	4	110
Lindley Creek	Stream	do.	5.6	112	0	188	0	0	0	188
Total or Average	Stream	1930 1931	411.1	8,222	46	165	16	9	1	237

The smallest amount of Ribes live stem left after eradication occurred on the Long Meadow Creek and the Deep and Elk creek infection areas where both stream and upland Ribes were removed. Following Ribes eradication in 1929 the check on the Long Meadow infection area showed 214 feet of live stem per acre. The 1931 reworking has reduced this to twelve feet per acre.

In spite of two successive workings there are still too large amounts of Ribes left per acre on each of the five streams shown, if the 50-foot limit is applied. On all but one of these areas R. lacustre makes up the bulk of the Ribes live stem after eradication.

By comparing Table No. 2 and Table No. 5 it will be seen that the amount of live stem as shown on the permanent plots is much larger than that shown as a result of temporary checking. This is partially explained by the fact that the results in Table No. 2 were obtained before while those in Table No. 5 were obtained after the 1931 reworking. However, as previously stated, permanent plots sample only the stream type supporting R. petiolare whereas temporary plots are applied to the entire drainage. Because Ribes are usually more abundant on the areas sampled by permanent plots, the amount left on these areas is usually greater.

B. Checking on the Clearwater Timber Protective Association Lands.

1. Permanent Plots. In Table No. 6 there are shown the results of checking by permanent plots on the Clearwater Timber Protective Association lands.

TABLE NO. 6

FEET OF LIVE STEM PER ACRE OF ALL RIBES SPECIES BEFORE AND AFTER ERADICATION
CLEARWATER TIMBER PROTECTIVE ASSOCIATION, 1 PER CENT CHECK BY PERMANENT PLOTS

Drainage	Year of Eradication	Before Eradication		After Eradication					
				Same Year as Eradication		1 Year After		2 Years After	
		Acres Checked	Feet Live Stem Per Acre	Acres Checked	Feet Live Stem Per Acre	Acres Checked	Feet Live Stem Per Acre	Acres Checked	Feet Live Stem Per Acre
Deer Creek*	1929	101.0	31,242	64.2	119	93.8	409	101.0	210
North Fork of South Fork Reed's Creek	1929	41.0	54,600	36.4	143	41.0	630	41.0	1,663
South Fork Reed's Creek	1929	64.4	28,980	47.6	90	60.6	236	64.4	657
North Fork Reed's Creek	1929	65.2	28,810	Not checked.		65.2	960	65.2	1,764
Alder Creek	1929	118.6	11,524	113.0	785	110.4	1,292	118.6	1,892
Loop Creek	1929	14.6	36,651	14.6	705	14.6	1,226	14.6	1,952
Total or Average	1929	404.8	27,238	275.8	404	385.6	782	404.8	1,234
Orofino Creek	1931	61.0	11,802	Not checked.		-	-	-	-

*Railroad spur built along creek in 1930-1931 probably accounts for the reduction of live stem per acre between 1930 and 1931.

With the exception of Deer Creek the amount of Ribes live stem on each drainage increased both the first and second years after eradication. Prior to eradication these areas all supported abundant Ribes growing in relatively wide and open stream types, thus offering good conditions for the growth and regeneration of Ribes following eradication.

In Table No. 7 the material on which Table No. 6 is based has been analyzed from the standpoint of Ribes species.

TABLE NO. 7

FEET OF LIVE STEM PER ACRE BY RIBES SPECIES AFTER ERADICATION, ALL DRAINAGES, CLEARWATER TIMBER PROTECTIVE ASSOCIATION, 1 PER CENT CHECK BY PERMANENT PLOTS

Year of Eradication	Year Checked	Acres Checked	Feet Live Stem Per Acre After Eradication			
			R. petiolare	R. lacustre	R. Inerme	Total Ribes
1929	1929	275.8	143	180	81	404
	1930	385.6	435	292	55	782
	1931	404.8	802	367	65	1,234

After Ribes eradication in 1929 there was approximately 25 per cent more R. lacustre than R. petiolare live stem per acre. During the two years from 1929 to 1931 the amount of R. petiolare increased nearly six times while the amount of R. lacustre increased slightly more than two times. In view of these facts it appears that R. petiolare is a more serious factor in repopulating areas than R. lacustre.

In Table No. 8 is shown a summary of data on the seedling population following Ribes eradication.

TABLE NO. 8

NUMBER OF RIBES SEEDLINGS PER ACRE ORIGINATING AFTER 1929 ERADICATION, CLEARWATER TIMBER PROTECTIVE ASSOCIATION, 1 PER CENT CHECK BY PERMANENT PLOTS

Drainage	*Acres Checked	Number Seedlings Per Acre					
		One Year After Eradication			Two Years After Eradication		
		R. pet.	R. lac.	Total	R. pet.	R. lac.	Total
Deer Creek	93.8 101.0	141	3	144	69	0	69
North Fork South Fork Reed's Creek	41.0 41.0	1,971	12	1,983	1,834	90	1,924
South Fork Reed's Creek	60.6 64.4	716	0	716	772	12	784
North Fork Reed's Creek	65.2 65.2	90	32	122	271	451	722
Alder Creek	110.4 118.6	55	27	82	105	22	127
Loop Creek	14.6 14.6	116	247	463	144	89	233
Total or Average	385.6 404.8	392	25	417	405	93	498

*The first number refers to one year, the second to two years after eradication.

There were no Ribes seedlings found which definitely originated the year of eradication which is the same condition noted on the Potlatch Timber Protective Association lands. On each of the six areas studied, Ribes seedlings germinated so profusely and were so well distributed as to promise the replacement of the original Ribes in a few years if not disturbed.

In contradistinction to the survival of seedlings as determined on the Potlatch eradication areas, the average number of seedlings per acre on the Clearwater areas was greater two years after eradication than at the end of the first year. This was particularly true of R. lacustre which increased nearly four times during this period.

2. Temporary plots. In Table No. 9 there are shown the results of checking by temporary plots on the Clearwater Timber Protective Association lands.

TABLE NO. 9

FEET OF LIVE STEM PER ACRE BY RIBES SPECIES AFTER ERADICATION, CLEARWATER TIMBER PROTECTIVE ASSOCIATION 1931, 2 PER CENT CHECK BY TEMPORARY PLOTS

Drainage	Year of Eradication	Acres Checked	Number of Milacres Checked	Feet Live Stem Per Acre by Ribes Species			
				R. pet.	R. lac.	R. vis.	Total Ribes
Deer Creek	1929 1931	229.9	4,598	54	46	1	101
North Fork South Fork Reed's Creek	1929 1931	31.0	620	50	23	0	73
South Fork Reed's Creek	1929 1931	77.1	1,542	7	8	0	15
Total or Average	1929 1931	338.0	6,760	43	35	Trace	78
Parallel Creek	1930	53.8	1,076	219	75	0	294
Meadow Creek	1930	31.4	628	103	66	0	169
Quartz Creek	1930	32.7	654	12	8	1	21
Calhoun Creek	1930	16.8	336	265	51	0	316
Snake Creek	1930	52.2	1,044	392	61	0	453
Poorman Creek	1930	103.4	2,068	403	432	11	846
Hay Creek	1930	21.7	434	0	21	0	21
McCauley Creek	1930	83.5	1,670	441	34	0	475
Gold Creek	1930	69.0	1,380	13	53	0	66
Ruby Creek	1930	33.6	672	0	929	35	964
Casey Creek	1930	59.0	1,180	96	61	0	157
Total or Average	1930	557.1	11,142	225	174	4	403

There are two main divisions of Table No. 9; the first showing the results of checking where Ribes eradication was done in 1929 and 1931

and the second showing results from areas worked only in 1930. From this table it is seen that the average feet of live stem remaining on areas where reeradication was performed in 1931 was only one-fifth the amount left on the areas worked for the first time in 1930.

With the exception of the South Fork of Reed's Creek, Quartz Creek and Hay Creek, none of the fourteen creeks checked showed the amount of Ribes left after eradication to be less than the 50 feet of live stem set up as the working objective. On both groups of streams approximately 55 per cent of the remaining live stem consisted of R. petiolare.

Comparing Table No. 6 with Table No. 9 we find that for the same areas, checking by permanent plots gives a larger amount of Ribes live stem per acre than by temporary plots. The same explanation that was made for this difference on areas checked in the Potlatch unit obtains here.

There is shown in Table No. 10 a comparison of Ribes conditions after the 1929 work and after the 1931 work. These results, while derived from checking on the same drainages, are based on plots totally independent of each other. The major difference in the work is that a 4 per cent check was made in 1929 and a 2 per cent check in 1931.

TABLE NO. 10

COMPARISON OF RIBES CONDITIONS AFTER THE 1929 ERADICATION WITH THOSE AFTER THE 1931 REERADICATION, CLEARWATER TIMBER PROTECTIVE ASSOCIATION, CHECK BY TEMPORARY PLOTS

Drainage	Years of Both Eradication and Check	Acres Checked	Per Cent Check	Mil-acres Studied	Feet of Live Stem Per Acre				
					R. pet.	R. lac.	R. iner.	R. vis.	Total Ribes
Deer Creek	1929	180.4	4	7,214	30	80	0	1	111
	1931	229.9	2	4,598	54	46	0	1	101
North Fork South Fork Reed's Creek	1929	76.7	4	3,070	19	45	0	0	64
	1931	31.0	2	620	50	23	0	0	73
South Fork Reed's Creek	1929	211.2	4	8,448	129	271	0	2	402
	1931	77.1	2	1,542	7	8	0	0	15
Total or Average	1929	468.3	4	18,732	73	160	0	1	234
	1931	338.0	2	6,760	43	35	0	Trace	78

Following the 1931 Ribes reeradication on Deer Creek and the North Fork of the South Fork of Reed's Creek, there was approximately the same

amount of Ribes live stem as was found after the initial work in 1929. On the South Fork of Reed's Creek the amount left in 1931 is less than 4 per cent as much as was left in 1929.

C. Checking on the Clearwater National Forest Lands

In Table No. 11 there are shown the results of checking by temporary plots on the Clearwater National Forest lands. No permanent plots have been established on this unit.

TABLE NO. 11

FEET OF LIVE STEM PER ACRE BY RIBES SPECIES AFTER ERADICATION, CLEARWATER NATIONAL FOREST, 2 PER CENT CHECK BY TEMPORARY PLOTS, 1931

Drainage	Year of Eradication	Acres Checked	Number of Milacres Checked	Feet Live Stem Per Acre by Ribes Species			
				R. pet.	R. lac.	R. iner.	Total Ribes
Cedar Creek	1930	93.6	1,872	178	32	0	210
Musselshell Creek	1930 1931	16.7	334	0	102	0	102
Eldorado Creek	"	192.3	3,846	158	52	2	212
Two Bit Creek	"	6.0	120	0	118	0	118
Dollar Creek	"	16.7	334	210	105	0	315
Lolo Creek	"	107.4	2,148	21	47	126	194
Mud Creek	"	21.7	434T	7	25	0	32
Total or Average	"	360.8	7,216	100	55	38	193

In addition to the checking work shown in Table No. 11, there was a total of 224 milacres checked on Four Bit Creek. Since this drainage was checked before the eradication work was completed, the results are not shown.

It is apparent from Table No. 11 that on only one stream, namely Mud Creek, have eradicative efforts succeeded in reducing the Ribes population to the required 50 feet of live stem or less. In all other drainages the amount left is from 2 to 6 times this amount.

SUMMARY

1. Results of checking in 1931 on 4,072.5 acres in Idaho where Ribes eradication was performed from 1929 to 1931 were based on 220 permanent plots having 6,840 milacres and 1,787 temporary plots having 74,998 milacres. The permanent plots represent a one per cent check of 684 acres and the temporary plots a 2 per cent check of 3,749.9 acres. Both systems of

checking were used on 6 of the 37 areas checked.

Twenty-seven permanent plots sampling 149.6 acres in two areas were established in 1931. Because Ribes eradication was not completed on these areas, the plots were not checked.

2. Checking was confined to areas on the Potlatch and Clearwater timber protective associations and the Clearwater National Forest.

3. On the assumption that reduction of Ribes to 50 feet of live stem or less per acre constitutes protection, checking in 1931 shows that 6 areas, comprising 2,142.5 acres, are satisfactory out of 34 areas with 4,072.5 acres checked. Thus it is seen that although only 18 per cent of the areas are satisfactory the acreage represented is almost 53 per cent of the total amount checked.

4. On all of the stream type areas checked where there was only one working, the increase in Ribes live stem was very pronounced one and two years after Ribes eradication. On the Potlatch Timber Protective Association areas, 100 feet of live stem left in 1929 amounted to 140 feet in 1930 and 145 feet in 1931. On the Clearwater Timber Protective Association areas, 100 feet left in 1929 increased to 194 feet in 1930 and to 305 feet in 1931.

5. No Ribes seedlings were found which originated the year of Ribes eradication but on all stream type areas checked there was a large crop of seedlings produced the following year. On the Potlatch areas the number of Ribes seedlings was greatly decreased between the first and second year while on the Clearwater areas there was a slight increase.

6. Stream type areas worked in 1929 or 1930 supported sufficient Ribes seedlings in 1931 to completely replace the original Ribes within a few years if left undisturbed.

PINE INFECTION SURVEYS IN IDAHO, 1931

By
E. L. Joy,
Junior Forester

In 1931 surveys were made of five pine infection centers in Idaho. From each area data were secured on the age and abundance of pine and pine infection, and the quantity of Ribes by species probably responsible for the infection. The areas studied are located on Deep Creek, Long Meadow Creek and Ruby Creek on the Potlatch Timber Protective Association; Deer Creek on the Clearwater Timber Protective Association, and Fishhook Creek on the St. Joe National Forest. The following are the reports of these surveys:

Introduction

The Deep Creek study area is seven miles from Elk River, Idaho, along the Orofino road and Deep Creek in township 39 north, range 2 east, section 12. In 1928 infection was found on Ribes petiolare along the stream at this point but no pine infection was located. No infection on either host was found here in 1929, the year of Ribes eradication in this drainage, or in 1930.

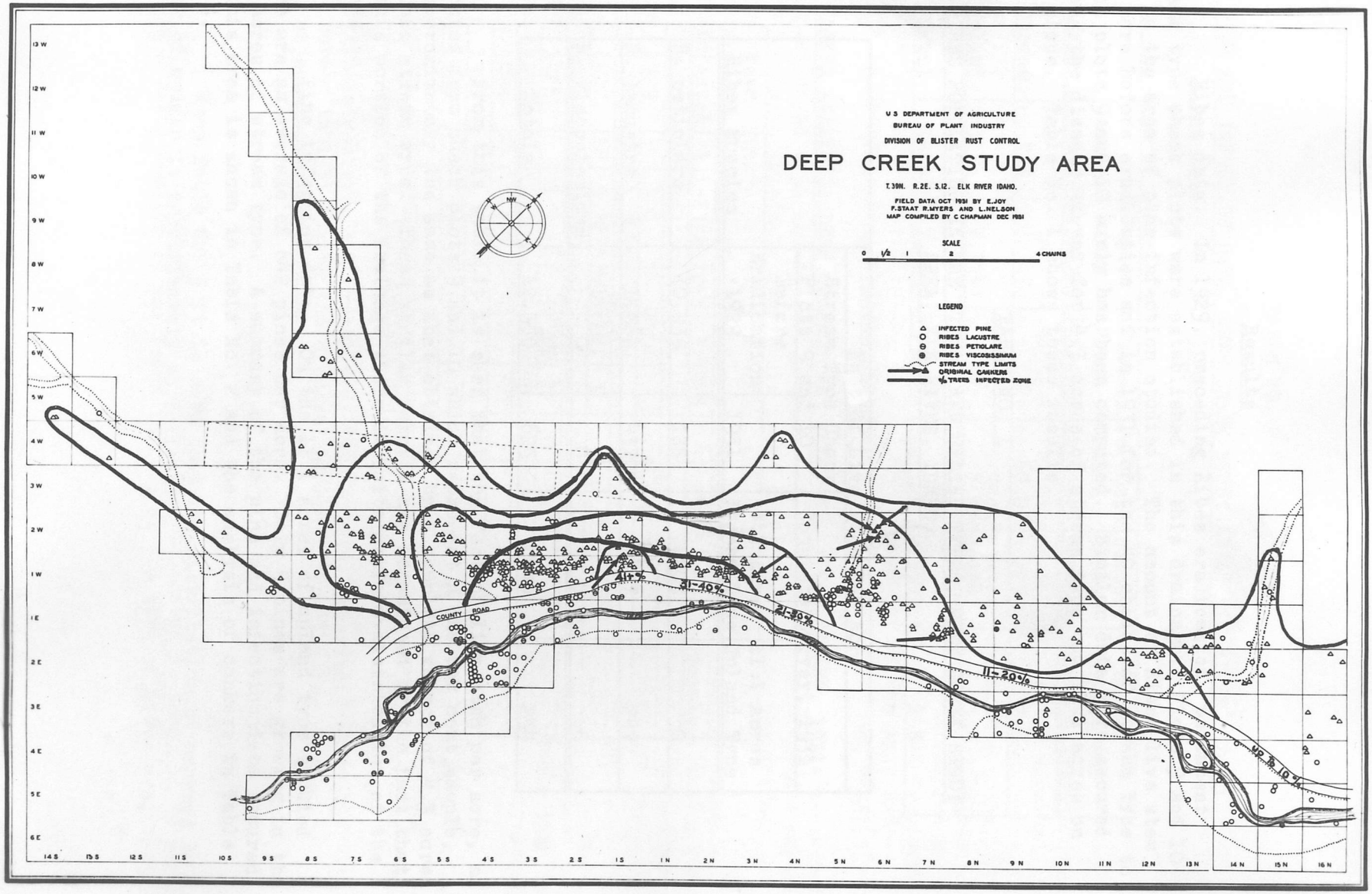
Scouting on this area in 1931 disclosed quite abundant pine infection which, from preliminary study, appeared to be entirely of 1928 origin. For this reason the area was selected for intensive study in order to obtain a measure of the amount of infection resulting in one year from a known amount of Ribes, and the effectiveness of protective measures in controlling the disease. It was soon discovered that this center was started in 1923 but because the majority of the cankers appeared to have originated in 1928 the study was continued.

Description of Area

The infection area, which is on a 35 to 45 per cent southeast slope, is in a narrow strip of dense 10 to 30-year-old white pine and Douglas fir reproduction which came in after a fire. Along the creek this strip is thirty chains wide, increasing in width up the slope. On both sides of the area and on the opposite slope are scattered mature trees left after logging.

Work Done

The area studied, comprising 15.4 acres, was surveyed into square-chain units and mapped. Infected pines and all Ribes were plotted and data taken on the abundance of Ribes, abundance and condition of pines, and amount of infection. Following is a map of the area showing the location of infected pines, location of Ribes, and pine infection intensity zones.


U S DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY
DIVISION OF BLISTER RUST CONTROL
DEEP CREEK STUDY AREA
T. 39N. R. 2E. S. 12. ELK RIVER IDAHO.
FIELD DATA OCT 1931 BY E. JOY
P. STAAT R. MYERS AND L. NELSON
MAP COMPILED BY C CHAPMAN DEC 1931
SCALE
0 1/2 1 2 4 CHAINS
LEGEND
INFECTED PINE
RIBES LACUSTRE
RIBES PETIOLARE
RIBES VISCOSISSIMUM
STREAM TYPE LIMITS
ORIGINAL CANKERS
1/2 TREES INFECTED ZONE
41+%
21-40%
11-20%
UP TO 10%
COUNTY ROAD
NW
13 W
12 W
11 W
10 W
9 W
8 W
7 W
6 W
5 W
4 W
3 W
2 W
1 W
1 E
2 E
3 E
4 E
5 E
6 E
14 S
13 S
12 S
11 S
10 S
9 S
8 S
7 S
6 S
5 S
4 S
3 S
2 S
1 S
1 N
2 N
3 N
4 N
5 N
6 N
7 N
8 N
9 N
10 N
11 N
12 N
13 N
14 N
15 N
16 N

Results

Ribes data. In 1929, preceding Ribes eradication, permanent stream type check plots were established in this drainage. Plots 9 and 10 are on the area of pine infection studied. The amount of Ribes live stem per acre before eradication and in 1931 for the 40 chains of stream type to which plots 9 and 10 apply has been computed. Similar data were secured during the disease survey for 4.3 acres of stream type and 11.1 acres on the slope. Table No. 1 shows these results.

TABLE NO. 1

RIBES POPULATION IN THE STREAM AND UPLAND TYPES, DEEP CREEK STUDY AREA, ELK RIVER, IDAHO

	Feet of Live Stem Per Acre			
	Stream Type Check Plots 9 and 10		Complete Survey, 1931	
Ribes Species	Before Eradication 1929	1931	4.3 Acres Stream Type	11.1 Acres Upland Type
R. petiolare	10,938	188	203	0
R. lacustre	1,562	437	437	249
R. viscosissimum	0	0	0	5
Totals	12,500	625	640	254

From this table it is seen that the feet of live stem per acre, as computed from check plots 9 and 10 which represent a one per cent sample, is approximately the same as that obtained by a complete survey of 4.3 acres of this stream type. These similar results are occasioned by the fact that on this portion of the drainage there is quite uniform distribution of the Ribes.

Pine infection data. On the 11.1 acres of upland type studied there are an average of 642 pines per acre. Only 5 pines are growing in the 4.3 acres of stream type. A summary of the pine and infection data secured on this area is shown in Table No. 2 and the analysis of cankers in Table No. 3.

TABLE NO. 2

PINE AND INFECTION DATA, DEEP CREEK STUDY AREA, ELK RIVER, IDAHO
1931

Type	Acres Studied	Number Pines Examined	Number Pines Infected	Per Cent Pines Infected	Number Cankers Found	Number Cankers Per Infected Tree
Stream	4.3	5	3	60.0	15	5.0
Upland	11.1	7,124	553	7.8	974	1.8
Total	15.4	7,129	556	7.8	989	1.8

TABLE NO. 3

CANKER ANALYSIS, DEEP CREEK STUDY AREA, ELK RIVER, IDAHO, 1931

Year Wood Infected	Number of Years Cankers Have Been in the Wood											
	1	1-2	2	2-3	3	3-4	4	4-5	5	6-8	?	Totals
1930	1											1
1929												0
1928	4	1	42	9	18							74
1927	12	5	273	104	167	3						564
1926	1	1	90	73	120	3						288
1925		1	6	3	17	1	1	2				31
1924						1						1
1923										1		1
1922										2		2
1921										3		3
? *											24	24
Totals	18	8	411	189	322	8	1	2	0	6	24	989

*These cankers, all probably of 1928 origin, were found on trees burned in 1931 during the disposal of brush from logging of the adjacent timber.

DISCUSSION

From Table No 3 it is seen that the distribution of cankers by year of origin is approximately as follows:

Year of Origin	Number Cankers
1923	6
1926-1927	11
1928	971
1930	1

Although canker analyses from other centers of 1923 origin disclose a high proportion of cankers originating in 1927, it is apparent that heavy intensification did not take place here until 1928. Scouting records for 1928 show that of 150 R. petiolare bushes examined at this point, 65 per cent of the leaves of 30 bushes were infected. With approximately 50 times as much Ribes live stem in the stream type as on the slope and an abundance of infection on R. petiolare, it follows that most of the large number of cankers originating in 1928 were caused by stream type Ribes. This is shown by the infection intensity zone lines on the map of this area.

Based on the percentage of total pines infected, it is seen that infection is most abundant within two chains of the stream type and rapidly decreases in abundance above this line. Using as a basis the average number of cankers per infected tree, the limits of the zone in which this average equals or exceeds the average for the plot practically coincide with the 21-30 per cent line shown on the map. It is apparent that a few of the upland Ribes have had a small amount of local effect in spreading the disease but the total amount is small when compared with the total effect of stream type Ribes.

The main spread of infection from stream type Ribes has been to the southwest and west as shown by the zone lines. It is probable that the two narrow, moist draws from the west have greatly influenced the movement of sporidia in that direction.

The effectiveness of protective measures in controlling the disease in the vicinity of the Deep Creek study area cannot be determined until the amount of pine infection originating since 1928 is measured. Data secured in 1931 have provided us with a measure of the amount of infection originating before the 1929 eradication work and are therefore invaluable as a basis for comparison with data to be secured later.

LONG MEADOW CREEK INFECTION SURVEY

Introduction

The Long Meadow Creek infection area located in township 39 north range 1 east, section 14 was found in 1929 at the time of Ribes eradication

in this drainage. Scouting showed that the area of infection extended for about 1/2 mile along Long Meadow Creek and slightly less up Three Bear Creek, a tributary. At three places, one on Long Meadow and two on Three Bear Creek, the disease was much more abundant than on the rest of the area. It was found that the disease had entered at these points in 1923.

A complete survey of the original Ribes population was not obtained because of the destruction of many bushes during Ribes eradication. The quantity of Ribes on 4.1 acres in the vicinity of the original center on Long Meadow Creek was determined before Ribes eradication. After eradication a complete survey was made of the Ribes left on 300 acres.

In 1930 a 4 per cent survey was made of the pine infection and Ribes abundance. Sample strips 13.2 feet wide were run across the drainage at 5-chain intervals. Data were taken by chain segments on each strip to the limits of infection.

Work Done in 1931

In 1931 Ribes reeradication was performed on 836 acres on and around the infection area after which a 2 per cent check for Ribes was conducted on 822.2 acres of this total.

Infection data were taken on alternate strips established in 1930. The strips reworked were extended to the new limits of infection. One additional strip was run at each end of the series of strips established on Long Meadow Creek and at the upper end of the series established on Three Bear Creek.

Results

Ribes data. On the Long Meadow area there is no definite stream type with concentrations of Ribes. Consequently the checking strips have been run across the drainage and include both stream and upland types. Table No. 4 shows the abundance of Ribes as determined by surveys in 1929, 1930 and 1931.

TABLE NO. 4

RIBES CONDITIONS ON THE LONG MEADOW INFECTION AREA AS DETERMINED FROM SURVEYS IN 1929, 1930 and 1931

Eradication Status	Year Checked	Acres Sampled	Per Cent Sample	Ribes F.L.S. Per Acre		
				R.lac.	R. vis.	Total
Before 1929 Eradication (2)	1929	4.1	100	1,881	27	1,908
Before 1929 Eradication (1)	1929	300.0	2	803	278	1,081
After 1929 Eradication (3)	1929	300.0	2	145	85	230
After 1929 Eradication (2)	1930	69.0	4	309	32	341
After 1931 Reeradication (3)	1931	822.2	2	9	3	12
After 1931 Reeradication (2)	1931	108.0	2	10	2	12

(1) Obtained by totaling estimated feet of live stem pulled by eradicators and feet of live stem found after eradication.
(2) Obtained as part of disease survey information.
(3) Results of checking after Ribes eradication.

Table No. 4 brings out the fact that on this area Ribes eradication in 1929 and 1931 has reduced the Ribes live stem to a figure much lower than 50 feet per acre, the amount arbitrarily used to denote protection.

Pine infection data. Where infection was found on nearly 48 acres in 1930, it now extends over approximately 100 acres. This increase is due chiefly to the spread farther up the slopes, although the limits were also extended down the Long Meadow Creek drainage. No appreciable extension was made above the 1930 limit on upper Long Meadow or Three Bear creeks.

It was the purpose to run the strips in 1931 so as to include the same trees that were examined in 1930. Due to the fact that in 1930 these strips were marked only at chain intervals by a stake placed in the middle of the strip, the trees were not tagged, and on several of the chain segments the trees had been destroyed during the construction of a railroad grade, practically no chain length strip segment showed the same number of trees found in 1930. The 1931 survey included many small trees which were not included in the 1930 survey. Because on the average a smaller percentage of the small trees are infected, inclusion of this class tends to make the percentage of trees infected lower for the 1931 survey than would be the case on the basis used in 1930.

Analysis of the data shows that pines were found and examined on 51 complete chain segments of strips surveyed in both 1930 and 1931. A comparison of pine and infection data from these segments is shown in Table No. 5.

TABLE NO. 5

COMPARISON OF PINE AND INFECTION DATA FROM THE 51 CHAIN SEGMENTS OF STRIPS UPON WHICH PINES WERE EXAMINED IN BOTH 1930 AND 1931

Strip	Chains Studied	Acres Sampled	Number Trees Examined		Number Trees Infected		% Trees Infected		Total Number Cankers	
			1930	1931	1930	1931	1930	1931	1930	1931
Long Meadow Creek										
2N	5	5	57	63	2	1	3.5	1.6	2	1
0	7	7	37	32	4	6	10.8	18.8	6	13
1E	5	5	73	152	0	19	0.0	12.5	0	29
3E	6	6	119	129	1	13	0.8	10.1	1	16
5E	3	3	70	37	1	0	1.4	0.0	1	0
Total	26	26	356	413	8	39	2.2	9.4	10	59
Three Bear Creek										
1W	11	11	72	237	6	75	8.3	31.6	7	152
3W	10	10	152	207	66	116	43.4	56.0	1,142	2,413
5W	4	4	138	143	1	47	0.7	32.9	1	107
Total	25	25	362	587	73	238	20.1	40.5	1,150	2,672
Both Areas										
Total	51	51	718	1,000	81	277	11.3	27.7	1,160	2,731

Strips 0 on Long Meadow Creek and 3W on Three Bear Creek pass through two of the three original centers of infection which accounts for the occurrence of the largest percentages of infected trees on these strips both in 1930 and 1931. The decrease in the percentages of infected trees in 1931 on strips 2N, which is above, and 5E which is below the old center on Long Meadow Creek is probably the result of failure in 1931 to examine the same trees used in 1930.

Although the strips passing through the two original centers show the largest percentages of trees infected, the rate of increase in pine infection between 1930 and 1931 is greatest on all other strips where an increase is shown. This is indicative of the fact that the disease is rapidly spreading to the areas around the original centers.

Because the number of trees examined on the 51-chain segments is not the same for both years, it follows that the true canker increase is not shown. In order to measure this increase the number of cankers probably extant in 1930 on the trees examined in 1931 was computed as follows:

$$1000:X::718:1160$$
$$X = 1616$$

If on the 1,000 trees examined in 1931 there were 1,616 cankers in 1930 and 2,731 in 1931, it follows that there was a 69 per cent increase in cankers during this one year. Using as a basis 120,000 cankers, the calculated total on the area in 1930, there were in 1931 approximately 202,800 cankers.

The infection at this center in 1923, the year of origin, consisted of approximately 83 cankers. The first aeciospores were produced by these cankers in 1926 which in turn caused the first new cankers. Increased aecial production by the original cankers in 1927 and 1928 started many more. In fact, from the survey it was found that the majority of the cankers visible in 1931 originated in 1927 and 1928, only a few of later origin showing.

If 83 cankers have in three years (1926-1928) caused 202,800 cankers the increase has been at the rate of 2,443 to 1. Referring to Table No. 4 we find that this rapid intensification of the disease has been caused by not over 1,908 feet of Ribes live stem per acre, the bulk of which was R. lacustre.

RUBY CREEK INFECTION SURVEY

Introduction

The Ruby Creek infection area found in July, 1931 is located from 4 to 8 miles south of Bovill, Idaho, along the Elk River road in township 40 north, range 1 east, sections 15 to 18, and range 1 west, section 13. Although the main body of infection, which includes the original center started in 1923, is at the confluence of Ruby and the East Fork of Potlatch creeks, continuous pine infection was found along the latter drainage for one-half mile above and one-half mile below the mouth of Ruby Creek and along Ruby Creek for three and three-fourths miles. No Ribes eradication had been performed in this drainage when the infection center was discovered.

Work Done

Permanent check plots were established at 20-chain intervals for four and three-fourths miles in the stream type of Ruby Creek in order to study the effect of Ribes eradication on the Ribes population of this area. From this one per cent check before Ribes eradication the amount of stream type Ribes was determined.

After the establishment of permanent check plots a 2 per cent survey of the infection area was started. During the course of the survey

a fire swept over most of this drainage making it impossible to secure data on the entire area of infection. Sufficient data were obtained to give information on the infection conditions around the old center at the confluence of Ruby and the East Fork of Potlatch creeks (area A); and a secondary center along upper Ruby Creek (area B). Area A extends along the East Fork of Potlatch Creek for one-half mile above and one-half mile below the mouth of Ruby Creek and up Ruby Creek for one mile. Area B extends up Ruby Creek two and one-fourth to three and three-fourths miles from its mouth.

Results

Ribes data. In Table No. 6 is shown the amounts of Ribes live stem per acre on four and three fourths miles of the Ruby Creek stream type and on areas A and B. The Ruby Creek portion of area A and all of area B are included in the check by permanent plots.

TABLE NO. 6

RIBES LIVE STEM PER ACRE, RUBY CREEK INFECTION AREA - 1931

Area	Type	Areas Checked	Per Cent Check	Feet of Live Stem Per Acre				
				R. pet.	R. inerme	R. lac.	R. vix.	Total
4-3/4 miles along Ruby Creek	Stream	88.6	1	6,781	90	5,699	0	12,570
A - East Fork Potlatch and Ruby creeks	Stream	27.0	2	5,331	238	1,611	0	6,180
	Upland	74.0	2	0	26	134	256	416
B - Ruby Creek	Stream	31.4	1	5,436	151	3,170	0	8,757

Although the survey of Ribes on four and three-fourths miles of the Ruby Creek stream type shows much more Ribes live stem per acre than was found on either of the two smaller units, it is notable that these differences are caused chiefly by differences in the amounts of R. lacustre. The distribution of R. petiolare is quite uniform throughout the entire stream type surveyed.

Pine infection data. In 1929 and 1930 logging operations removed the mature white pine from most of the Ruby Creek drainage leaving a scattered stand of 20-40-year-old reproduction. On the two areas studied these young trees occurred at the rate of 200 per acre. The results of the pine infection survey on areas A and B are presented in Table No. 7.

TABLE NO. 7

RESULTS OF TWO PER CENT SURVEY OF PINE INFECTION, RUBY CREEK, 1931

Area	Acres Sampled	Number Pines Examined	Number Pines Infected	Per Cent Pines Infected	Number Cankers	Number Cankers Per Infected Tree
A	101.0	355	159	44.8	2,345	15.5
B	31.4	183	23	12.6	52	2.2
Total or Average	132.4	538	182	33.8	2,397	13.2

In addition to the 2 per cent survey on area A the infection conditions on 3 square chains of dense reproduction within this area at the original center were studied. Of 362 pines examined, 339 or 93.6 per cent were infected with an average of 19 cankers per tree.

The original center of infection probably started 8 years ago in 1923 while the secondary center on area B originated 4 years later in 1927. Table No. 2 shows that on 101 acres around the original center the pine infection developing in 8 years consists of over 3 times the percentage of infected trees with 7 times as many cankers per infected tree developed in four years at the secondary center. From data secured on the 3 square chains, infection at the original center consists of over 7 times as many infected trees with over 8 times as many cankers. These comparisons emphasize the fact that with continuous aeciospore production after three years the spread and intensification of blister rust is at a very rapid rate.

DEER CREEK INFECTION SURVEY

Location

The Deer Creek infection area which was found in July, 1931 is located near the Clearwater Timber Protective Association headquarters, Idaho in township 38 north, range 5 east, sections 23 and 26. The infection extends for 60 chains up Deer Creek from its confluence with the South Fork of Reed's Creek.

Work Done

It was determined that infection on this area occurs only within a narrow strip approximately one chain wide along each side of the stream type.

All pines within this strip were examined and an analysis made of the infection found.

Results

Ribes data. Preceding Ribes eradication in 1929 permanent check plots were established in this drainage for the purpose of studying the effect of Ribes eradication on the Ribes population. These plots were examined after eradication in 1929 and again in 1930 and 1931.

Plots 1 to 4 are a one per cent sample of the Ribes conditions adjacent to the pine infection area. Because of the construction here in 1930 and 1931 of a logging railroad these plots were either wholly or partially disturbed and do not, therefore, provide data representative of the conditions on this area in 1931. The following tabulation shows the quantity of Ribes petiolare, the only species found, before and after Ribes eradication in 1929 and one year later.

Before eradication, 1929.....	69,610	feet	live	stem	per	acre
After eradication, 1929.....	332	"	"	"	"	"
One year after eradication, 1930.	49	"	"	"	"	"

Of the 49 feet of R. petiolare live stem per acre found one year after Ribes eradication, approximately 40 feet is made up of seedlings. Although construction of the railroad grade disturbed plots 1 to 4 to such an extent that accurate data could not be secured from them in 1931, it is estimated from observations that the Ribes population on this area was not much greater than the 49 feet per acre found in 1930.

Pine infection data. There is an excellent stand of 40-60-year-old white pine adjacent to this part of the Deer Creek drainage. Under this stand is a scattering of 20-40-year-old suppressed trees. Both classes together occur at the rate of approximately 500 trees per acre.

From the infection survey it was found that approximately 3 per cent of the pines are infected. Following is the analysis of cankers found on the 168 infected trees.

TABLE NO. 8

ANALYSIS OF CANKERS, DEER CREEK INFECTION AREA, 1931

Year Wood Infected	Canker Stages							
	First Symptom	Juvenile	First Pycnia	Second Pycnia	Fruited 1	Fruited 2	Fruited Several	Total
1929		1						1
1928		16	6	10	1			33
1927	1	65	39	29	1			135
1926	1	35	30	43	9	2		120
1925		3	3	9		2	1	18
1924			1		2	1		4
1923					1			1
1920						1		1
Total	2	120	79	91	14	6	1	313

It has been determined that the disease probably entered this area in 1923. From Table No. 8 it is seen that there was a large increase in the number of cankers in 1928, the year preceding Ribes eradication. At that time R. petiolare occurred at the rate of approximately 69,000 feet of live stem per acre. This study will be continued in order to obtain a measure of the amount of infection resulting from the small amount of R. petiolare live stem each year since Ribes eradication.

FISHHOOK CREEK INFECTION SURVEY

Introduction

The Fishhook Creek infection area, one of the largest known centers in the Inland Empire, was found in the summer of 1931. The original center of infection, which started about 1923, is around a small clump of R. petiolare growing in a marshy seep on the west slope about 10 chains above the creek. From this small beginning, the disease has in 8 years spread until it now extends approximately one and one-half miles along the creek over an area of at least 100 acres.

Location

This area is located on the St. Joe National Forest about 10 miles southwest of Avery, Idaho in township 44 north, range 5 east, sections 4, 5, 8 and 9. It is between five and six miles above the St. Joe River into which this creek flows.

Description of Area

The topography of the Fishhook Creek drainage is very rough, the streams flowing through deep, rocky canyons. The slopes are steep and marked in many places by rock outcrop which usually forms a dry slope supporting very little if any tree growth. White pine of the 20-40-year age class occurs in the moist pockets near the stream and for three to six chains up the slope if there is sufficient soil to hold moisture.

The main body of infection is along Fishhook Creek above the mouth of Lick Creek, a large tributary. Twenty-six chains above this point is a rock cliff extending for 500 feet along the creek. The slope above this cliff is dry and treeless, forming a natural break in the white pine type. The original center of infection is within the area upstream from this barren slope.

Work Done

A complete survey was made of the Ribes abundance and pine infection conditions on 22.35 acres. This consisted of a survey of the stream type Ribes for 78 chains below the mouth of Lick Creek and of the stream type and upland Ribes and pine infection conditions for 52 chains above this point. Data were taken on the occurrence and abundance of Ribes, pines and pine infection.

Results

Ribes data. Table No. 9 has been derived from the survey data and shows the abundance of Ribes live stem in the stream type, upland pine type, and upland rock outcrop type.

TABLE NO. 9

ABUNDANCE OF RIBES LIVE STEM ON 22.35 ACRES OF THE FISHHOOK CREEK INFECTION AREA, 1931 COMPLETE SURVEY

Type	Acres Surveyed	Ribes Feet Live Stem Per Acre				
		R. petiolare	R. lacustre	R. irriguum	R. viscosissimum	Total
Stream	12.50	1,161	33,343	260	0	34,764
Upland pine	8.85	1	3,424	1,103	1	4,529
Upland rock outcrop*	1.00	0	0	200	500	700
All Types	22.35	650	20,004	591	23	21,268

*The small area of this type surveyed is above the rock cliffs. On this dry and exposed area were found six R. irriguum and 2 R. viscosissimum bushes which accounts for the 700 feet of live stem recorded.

From Table No. 9 it is seen that R. lacustre is the most abundant species on this area followed by comparatively small quantities of R. petiolare, R. irriguum and R. viscosissimum. R. petiolare occurs in small clumps at intervals in the stream type while R. irriguum is for the most part found on the upland type. R. lacustre is most abundant in the moist areas adjacent to the stream but is also found scattered throughout the upland type, especially where the moisture is sufficient for good pine growth.

Pine infection data. Of the 22.35 acres surveyed only 8.85 acres are white pine type. This includes 5.05 acres in area "A" which is below the rock cliff and 3.8 acres in area "B" which is above. In Table No. 10 is shown the summary of pine infection data taken on these areas.

TABLE NO. 10

PINE INFECTION CONDITIONS ON 8.85 ACRES OF THE FISHHOOK CREEK INFECTION AREA. 1931

Area	Number Acres	Number Pines Per Acre	Number Pines Examined	Number Pines Infected	Per Cent Pines Infected	Number Cankers Found	Number Cankers Per Infected Tree
A	5.05	324	1,216	410	33.7	1,087	2.7
B	3.80	264	652	345	52.9	2,242	6.5
Total or Average	8.85	298	1,868	755	40.4	3,329	4.4

It is evident from Table No. 10 that 19 per cent more infected pines with 2.4 times as many cankers were found on area B than were found on area A. The average distance from the original center of infection to pines on area B is only one-half the average distance to the pines on area A.

From a further analysis of the Ribes data it was found that the average Ribes population on area B is 6,100 feet of live stem per acre, or only one-fifth that of area A. It is apparent, therefore, that on the Fishhook Creek infection area 6,100 feet of Ribes live stem per acre in close proximity to the original source of aeciospores has caused 19 per cent more infected pines with 2.4 times more cankers than were caused by five times as much Ribes live stem at only twice the distance.

From the disease survey and observations it is estimated that the original nucleus for this infection area consisted of 50 cankers started in 1923. Probably a few of these cankers produced aeciospores for the first time in 1926 and the majority of them in 1927 and 1928. From these spores the Ribes became infected and in turn caused more pine infection.

In 1929 a few of the cankers formed in 1926 probably produced aeciospores for the first time. Because very few cankers were found in 1931 that had originated later than 1928, the 150,000 cankers on this area in 1931 (calculated from disease survey data) are considered as direct products of the 50 original cankers. It is evident, therefore, that during the first three years of disease intensification on the Fishhook Creek infection area, approximately 21,000 feet of Ribes live stem per acre (Table No. 9) has caused an increase in cankers at the rate of 3,000 to 1.

The only other known center in the Inland Empire where the rust intensification rate is comparable to that of the Fishhook Creek area is the Long Meadow infection which was found in 1929. It is estimated that the increase in cankers at Long Meadow during 1926, 1927 and 1928 was at the rate of 2,742 cankers for each canker of 1923 origin. Although no complete survey of the Ribes conditions was made before eradication in 1929, the available data indicate that from 1,000 to 2,000 feet of live stem per acre of R. lacustre and R. viscosissimum was responsible for this intensification. If not to exceed 2,000 feet of Ribes live stem per acre has caused almost as great an increase in cankers as over 21,000 feet per acre, irrespective of the species involved, it seems likely that the canker increase on the Fishhook Creek area will be greater during the period 1929-1931 than it was during the period 1926-1928.

SUMMARY OF BLISTER RUST PINE INFECTION SURVEYS IN IDAHO, 1931

Table No. 11, derived from disease survey data taken in 1931 on 5 areas where blister rust entered in 1923 shows the abundance of pine infection and Ribes live stem on each of these areas.

TABLE NO. 11

ABUNDANCE OF PINE INFECTION AND RIBES LIVE STEM ON 5 AREAS SURVEYED IN 1931

Area	Acres Sampled	Per Cent Sampled	Per Cent Pines Infected	No. Cankers Per Infected Tree	Ribes Feet Live Stem Per Acre	
					Stream	Upland
Deep Creek	15.4	100	7.8	1.8	12,500	254
Long Meadow Creek	51.0	2	27.7	9.9	0	1,981
Deer Creek	12.0	100	3.0	1.9	69,610	0
Fishhook Creek	8.9	100	40.4	4.4	34,764	4,529
Ruby Creek	132.4	2	33.8	13.2	6,180	416

It is notable that on these areas the amount of pine infection evident after 8 years varies as much as 37 per cent. Apparently the abundance of Ribes live stem is not in all cases the chief factor responsible for the rapid intensification of the disease as is evidenced by the fact that the smallest amount of infection and largest amount of Ribes occur on the Deer Creek area while the third largest amount of infection was found on Long Meadow Creek where the smallest amount of Ribes occurred. Topography, moisture conditions, wind currents, ground cover, exposure and other factors probably have considerable influence on the rate of intensification. In spite of this probability much of the Inland Empire white pine belt is made up of areas similar to those surveyed and should therefore present as favorable opportunities for rust intensification. Thus it is seen that the occurrence of as little as 2,000 feet of Ribes live stem per acre must be considered as a serious threat to the white pine on any area in the Inland Empire.

WHITE PINE PLANTATIONS ESTABLISHED 1931

By
E. L. Joy
Junior Forester

INTRODUCTION

In May, 1931, white pine plantations were established on seven pine infection areas in the Inland Empire white pine belt. Three of these plantings are on the Potlatch and three on the Clearwater timber protective association lands, Idaho and one on the study plot at Newman Lake, Washington. On the six association areas Ribes eradication had been performed prior to planting. On the Newman Lake area the Ribes inerme was removed in 1929, leaving only R. lacustre to spread the disease.

PURPOSE

These plantings were established for the purpose of determining the amount of pine infection that will result from Ribes left after eradication. Incidental to the main purpose, a study will be made of the comparative susceptibility to blister rust of the three species of white pine planted.

WORK DONE

Disease free transplants from the Wind River Forest Nursery at Carson, Washington, were planted at 3.3 foot-intervals in rows 3.3 feet apart. Equal numbers of Pinus monticola and P. strobus were planted on five areas, one of which had an additional lot of 364 P. flexilis. On the sixth area there were planted 11 more P. monticola than P. strobus and on the seventh P. monticola only.

Stakes were set to mark the boundaries of each plantation and each row of pines. The feet of Ribes live stem on each plot and on a surrounding strip one chain wide was determined. Each planting and the adjacent area were mapped.

Planted pine and Ribes data for the plantations are shown in Table No. 1:

TABLE NO. 1

PLANTED PINE AND RIBES DATA FOR SEVEN WHITE PINE PLANTATIONS ESTABLISHED MAY, 1931

Forest Unit	Plantation Location	Acreage Planted	Date Planted (May)	Number Pines Planted				Total Feet Ribes Live Stem				
				P. mont.	P. stro.	P. flex.	Total	R. pet.	R. lac.	R. visc.	R. irrig.	Total
Mt. Spokane Washington	Newman Lake	0.585	8-11	988	988	364	2,340	0	4,245	0	0	4,245
Potlatch Timber Protective Association Idaho	Cameron Creek	0.397	21.22	793	793	0	1,586	29,865	92	0	0	29,957
	Elk Creek	0.469	23.24	836	836	0	1,672	104	358	10	1,963	2,435
	Johnson Creek	0.273	25.26	532	532	0	1,064	102	967	92	0	1,161
	Unit Total	1,139		2,161	2,161	0	4,322	30,071	1,417	102	1,963	33,553
Clearwater Timber Protective Association Idaho	Quartz Creek	0.708	27.31	1,422	1,411	0	2,033	1,450	0	0	0	1,450
	Orofino Creek	0.367	28.29	643	643	0	1,286	1,390	335	110	0	1,835
	North Fork Reed's Ck.	0.199	30	778	0	0	778	217	10	0	0	227
	Unit Total	1.274		2,843	2,054	0	4,897	3,057	345	110	0	3,512
All Units	Grand Total	2.998		5,992	5,203	364	11,559	33,128	6,007	212	1,963	41,310

Due to a protracted period of drouth following planting, there was a high death of transplants. Only one plantation, that on the Newman Lake plot, was completely checked for survival. This check made three months after planting showed pine survival as follows:

P. monticola	41.6%
P. strobus	52.2%
P. flexilis	34.3%
Average	45.0%

From this check and observations on the other six plantations, it is estimated that only forty to fifty per cent of the pines planted will be alive in 1932.

PROGRESS REPORT ON THE NEWMAN LAKE INFECTION STUDY
NEWMAN LAKE, WASHINGTON, 1931

By
R. E. Myers,
Agent

INTRODUCTION

White pine blister rust was found on the Newman Lake area May 10, 1928. It was determined that the disease probably entered on Ribes inerme in 1923. Thorough scouting in this region has failed to reveal any additional areas of infection.

Because only R. inerme and R. lacustre occur in this vicinity, it was decided that a study should be made of the disease spreading power of R. lacustre after the removal of R. inerme. Preliminary surveying and mapping for a study plot were accomplished in the fall of 1928 and spring of 1929. The area was completely covered twice in May, 1929, for the eradication of R. inerme and again during the summer when the locations of white pines and R. lacustre bushes on 25.4 acres were plotted and examined for infection. Data were recorded on the size and age of pines, size of Ribes and amount of infection on both hosts. All R. inerme bushes found during this period were removed.

In 1930 the area was reworked for R. inerme and the pines and Ribes on an additional 10.8 acres plotted. Host plants on the entire plot area of 36.2 acres were examined and infection data recorded.

Disease studies have indicated that weather, especially moisture, greatly affect the spread and intensification of blister rust. For the purpose of studying this relation, sling psychrometer readings were taken thrice daily in 1930 from which were computed relative humidities.

WORK DONE, 1931

A. Establishment of Pine Plantation

For the purpose of augmenting the study of disease spreading power of R. lacustre and at the same time to study the relative susceptibility to blister rust of three species of white pine, 988 each of Pinus monticola and P. strobus and 364 P. flexilis transplants from the Wind River Forest Nursery at Carson, Washington, were planted on the plot in 7 units. This stock was spaced at 3.3 foot intervals in rows 3.3 feet apart.

Because of an extremely dry period immediately following planting, there was a high death of transplants. On August 20 a check of the plantation showed a survival of 41.6 per cent for P. monticola, 52.2 per cent for P. strobus and 34.3 per cent for P. flexilis or an average of 45 per cent for all species.

B. Eradication of R. inerme

For the third consecutive year the Newman Lake plot and adjacent areas were covered for the removal of R. inerme. The results of all Ribes eradication on this area are shown in Table No. 1.

TABLE NO. 1

TOTAL RESULTS OF R. INERME ERADICATION
NEWMAN LAKE INFECTION AREA, WASHINGTON

Date Worked	Acres Worked	Total Feet of Live Stem Eradicated	Feet of Live Stem Per Acre
May 5-7, 1929	45.0	121,404	2,698
" 27, 28, 1929	45.0	4,487	100
June-August, 1929	25.4	993	39
Total, 1929	45.0	126,884	2,820
May 6, 7, 1930	45.0	891	20
June-August, 1930	36.2	121	3
Total, 1930	45.0	1,012	22
April 23, 1931	45.0	* 454	10
June-August, 1931	36.3	62	2
Total, 1931	45.0	516	11
Grand Total	45.0	128,412	2,853

*An additional 242 feet pulled from roadside approximately one-quarter mile from the plot.

C. Establishment of Cooperative Weather Station

Through the cooperation of the Spokane office of the United States Weather Bureau a temporary weather station was established and started on June 9 in order to more accurately measure the meteorological factors affecting the spread and intensification of the disease. The equipment consisted of a shelter house, anemometer, rain gauge and record forms from the Weather Bureau and a hygrothermograph, sling psychrometer and maximum-minimum thermometer from this office.

Readings were taken three times daily and recorded on the standard form No. 1009E. A copy of each 10-day record upon its completion was sent to the Spokane Weather office where the data were analyzed and used in fire weather reports. From the annual report prepared by Mr. F. C. Crombie, fire weather forecaster for the Inland Empire forest area, have been gleaned the weather comparisons shown in Table No. 2. The stations used were selected because they represent the approximate elevation range of the majority of the white pine stands in the Inland Empire.

TABLE NO. 2

PRECIPITATION AND RELATIVE HUMIDITY DURING SUMMER 1931 AT 12 STATIONS IN THE INLAND EMPIRE FOREST AREAS AND AVERAGE FOR ALL STATIONS

Portion of Inland Empire Forest Area	Station	Elevation	June 21-Sept. 10 Inches Precipitation	1,728 Hours, July 1 - to Sept. 10 Number Hours R.H. Over 35%	Average Relative Humidity A.M.	P.M.
Clearwater and Potlatch Forests, Idaho - (southern)	Musselshell Ranger Station	3,206	1.74	-	68	47
	Bungalow Ranger Station	2,250	1.55	-	69	48
	Headquarters	3,242	2.18	1,350	93	67
	Elk River	2,917	1.82	-	74	51
	Bovill	2,853	1.40	1,153	65	30
St. Joe National Forest, Idaho and western Montana (east central)	Avery	2,492	1.41	-	69	41
	Savenac	3,141	1.99	-	70	40
	Missoula	3,227	2.75	912	53	28
Priest River, Idaho northeastern Washington - (northern)	Priest River	2,380	1.98	-	61	33
	Sullivan Lake	2,500	2.68	1,423	65	49
Eastern Washington - (east central)	Spokane	1,929	0.90	760	58	24
	Newman Lake	2,600	2.07	1,401	58	38
Average	12 Stations	2,728	1.87	1,167	67	41
Average for entire area	21 Stations	3,841	2.04	*1,221	65	44

*Average for 10 stations.

Although the precipitation at Newman Lake was exceeded at only three of the eleven other stations, it is notable that the amount approximates the 21-station average for the Inland Empire forest area. The number of hours the relative humidity was over 35 per cent exceeds the average more than did the rainfall, but the average relative humidity both in the morning and in the afternoon is comparatively low. From these comparisons it appears that at Newman Lake the weather conditions are in general fairly representative of those found throughout the white pine belt.

Sufficient data are not yet available for any correlation between weather conditions and infection. The continuation of the Newman Lake weather studies over a period of years coincident with the collection of infection data during the same period is necessary before definite conclusions can be made.

D. Ribes Data

During the summer three inspections were made of 598 R. lacustre bushes on the plot and quantitative estimates of infection recorded. The number of bushes, classified as to the shade form, that were infected at each inspection is shown in Table No. 3, while Table No. 4 gives the analysis of infection on these bushes.

TABLE NO. 3

NUMBER OF R. LACUSTRE BUSHES, BY SHADE FORMS, INFECTED AT EACH INSPECTION NEWMAN LAKE, WASHINGTON, 1931

Degree of Shading	Period of Examination	Total Number Bushes Examined	Number Bushes Infected					Per Cent Total Bushes Infected to Date
			At Previous and Present Examinations	Newly Infected	Total	Previously But not When Examined	Total to Date	
No shade	June 12-24	49	0	7	7	0	7	14.3
	July 13-20	49	6	3	9	1	10	20.4
	Aug. 3-12	49	9	0	9	1	10	20.4
Half shade	June 12-25	330	0	81	81	0	81	24.5
	July 13-27	330	71	26	97	10	107	32.4
	Aug. 3-14	330	84	12	96	23	119	36.1
Full shade	June 12-30	219	0	36	36	0	36	16.4
	July 13-22	219	32	17	49	4	53	24.2
	Aug. 3-14	219	37	7	44	16	60	27.4
All forms	June 12-30	598	0	124	124	0	124	20.7
	July 13-27	598	109	46	155	15	170	28.4
	Aug. 3-14	598	130	19	149	40	189	31.6

TABLE NO. 4

ANALYSIS OF INFECTION ON LIVING LEAVES OF R. LACUSTRE, NEWMAN LAKE, WASHINGTON, 1931

Degree of Shading	* Inspection	Total Number Leaves Infected	Per Cent Infection Per Infected Leaf	Total Infection Converted to Equivalent Number Leaves 100 Per Cent Infected			
				Uredinia	Telia	Necrotic	Total
No shade	1	106	1.9	1	1	0	2
	2	201	** 10.0	6	12	2	20
	3	333	3.3	0	3	8	11
Half shade	1	1,186	3.6	25	11	7	43
	2	8,171	8.7	50	430	227	707
	3	11,374	9.4	87	693	294	1,074
Full shade	1	320	3.7	5	4	3	12
	2	2,164	7.2	26	113	17	156
	3	1,465	7.2	15	64	26	105
All forms	1	1,612	3.5	31	16	10	57
	2	10,536	8.4	82	555	246	883
	3	13,172	9.0	102	760	328	1,190

* For dates of inspection aee Table No. 3.

** This large increase caused by one bush with unusually heavy infection in July, but with much lighter infection in August due to defoliation.

Table No. 3 shows that of the total number of R. lacustre bushes examined during the season, a higher percentage of those in half shade were infected than of those completely shaded or in the open. Also, the percentage of infected bushes in half shade is higher than the average for all forms.

Newly infected bushes of all forms were found in July, one month after the initial inspection, but only of the half and full-shade groups in August. At both the second and third inspections the largest percentages of newly infected bushes were in half shade, although this percentage was not much greater than for full-shade bushes. The general indication from these results is that partially shaded R. lacustre bushes become infected more readily than those in full shade or no shade.

The analysis of infection on these bushes (Table No. 4) reveals the fact that the amount of infection, expressed as "per cent infection per

infected leaf" was also, in general, greatest on bushes of the half-shade form, although the infection of half-shade and full-shade forms was approximately the same at the first inspection. The large increase in the no shade group at the second inspection has been discounted because of the tremendous influence of one heavily infected bush.

The production of telia, the stage responsible for pine infection, increased between June and July but decreased between July and August except on half-shade bushes. A majority of the half-shade bushes showed a decrease in telia production between July and August, although the total shows an increase. Here again the influence of several large heavily infected bushes is seen.

On the basis of the analysis in Table No. 4 there has been computed the amount of telia production as determined by one inspection in 1929 and one in 1930. A comparison of these amounts with those from three inspections in 1931 follows.

TABLE NO. 5

COMPARISON OF AMOUNT OF TELIA PRODUCED IN 1929, 1930, AND 1931

Period Examined	Computed Number of Leaves 100 Per Cent Infected With Telia	Per Cent of Total Infection Which is Telia
June-August 1929	0.02	2.4
June-August 1930	31.00	53.4
June 1931	16.00	28.0
July 1931	555.00	62.8
August 1931	760.00	63.9

From this comparison it is seen that there was a tremendous increase in telia production between 1929 and 1930 and another substantial increase between 1930 and 1931. Although comparative weather records are not available for 1929 and 1930, rainfall on 16 days between June 12 and July 12 is probably responsible for much of the increase in 1931.

The volume of aeciospores produced during these years is also an important factor. Table No. 6 shows the number of aeciospore producing cankers and infected R. lacustre and their distribution for each year.

TABLE NO. 6

NUMBER AND DISTRIBUTION OF AECIOSPORE-PRODUCING CANKERS AND INFECTED RIBES LACUSTRE BUSHES, NEWMAN LAKE, WASHINGTON

Year	Number Fruiting Cankers	No. Infected R. lac.	Per Cent R. lac. Bushes Infected	No. Square Chains With Fruiting Cankers	No. Square Chains With Infected R. lac.	Maximum Distance From Fruiting Cankers to Infected Ribes
1929	18	6	1.1	9	5	165 ft.
1930	253	62	10.7	22	38	726 ft.
1931	913	189	31.6	43	88	924 ft.

For each infected R. lacustre bush there were 3 aeciospore producing cankers in 1929, 4.1 in 1930 and 4.8 in 1931. On the area basis for each square chain with infected R. lacustre, there were 1.8 square chains on which were found fruiting cankers in 1929, .6 in 1930 and .5 in 1931. These comparisons and the increase in spread distance from infected pines to Ribes (Table No. 6, last column) show that with the tremendous increases in aeciospore production there were almost as large increases in the number of infected Ribes bushes and a substantial increase in the area over which these bushes were distributed.

E. Pine Infection Data

In Table No. 7 the pine infection data collected in 1931 is compared with similar data secured in 1929 and 1930. Table No. 8 shows the analyses of cankers found during these three years.

TABLE NO. 7

PINE INFECTION DATA FOR 1929, 1930 AND 1931, NEWMAN LAKE, WASHINGTON

Item	Year		
	1929	1930	1931
Number of acres studied	25.4	36.2	36.3
Total number of pines on plot	977.	1,664.	1,667.
Total number of pines examined	752.	(a)1,334.	1,336.
Total number of pine infected	(b)66.	113.	128.
Per cent of pine infected	8.8	8.5	9.6
Number of pines killed by blister rust	0.	0.	4.
Total number cankers (c)	565.	1,591.	1,935.
Number of cankers per infected pine	8.6	14.2	15.1
Number of cankers per M feet total needle-bearing stem	8.5	16.5	19.4

(a) Includes 6 not in 1930 report.
(b) Total 68 in 1929 and 1930 reports included 2 trees with cankers which in 1931 were determined not blister rust.
(c) Revised Totals. Include individual hits making up multiple-hit cankers. Does not include 21 cankers removed in 1928.

TABLE NO. 8

ANALYSES OF CANKERS FOUND IN 1929, 1930 and 1931, NEWMAN LAKE, WASHINGTON

Year Data Taken	Year Wood Infected	Canker Stage								
		First Symptoms	Juvenile	Current Year Pycnia	One Year Old Pycnia	Fruited Once	Fruited Twice	Fruited Several	Dead	Totals
	1927	16	8	1						25
	1926	190	99	3		1				293
	1925	98	47	4						149
	1924	35	25	4	1	1	1			67
	1923	4	2	1		1		2	1	11
	1922						1	8	2	11
	1921							3	4	7
	1920								1	1
	1919									
	1918							1		1
1929	Totals	343	181	13	1	3	2	14	8	565
	1928		6	1						7
	1927	8	152	51		28			2	241
	1926	10	467	199	3	149			27	855
	1925	7	160	107	4	60			21	359
	1924		28	11	3	28		1	20	91
	1923		4	1		4			5	14
	1922		1			1	3	6	4	15
	1921					1			6	7
	1920								1	1
	1919									
	1918								1	1
1930	Totals	25	818	370	10	271	3	7	87	1,591
	1928	2	2	7	4	13			4	30
	1927		16	32	49	185	12		52	346
	1926		31	46	136	494	75		210	992
	1925		16	19	64	172	24		126	421
	1924		4	4	12	31	7		46	104
	1923		2	1		5	2		7	17
	1922		1		1		1	5	7	15
	1921				1			2	5	8
	1920								1	1
	1919									
	1918							1		1
1931	Totals		72	109	267	900	121	8	458	1,935

With the eradication of R. inerme in 1929 the influence of this species as a disease spreading agent after 1928 was removed. It was expected that the bulk of the cankers from the 1928 and many more from the 1927 exposure would appear in 1930 and 1931. Furthermore, the first cankers from R. lacustre infected in 1929 should have appeared in 1931.

Table No. 7 shows that in 1930, with the examination of 77 per cen more pines than in 1929 there was an increase of 182 per cent in the number of cankers found. In 1931 the canker increase over 1930, with approximately the same examined tree basis, amounted to 22 per cent.

The analyses of these cankers (Table No. 8) show that the majority are on 1926 wood resulting from exposure in 1927. In 1930, 7 cankers were found on 1928 wood (the most accurate measure of the 1928 cankers) whereas in 1931 there were 30. No cankers were found on 1929 wood. Table No. 9 shows the distribution of cankers by the years of wood infected.

TABLE NO. 9

DISTRIBUTION OF CANKERS FOUND IN 1929, 1930 AND 1931 BY YEARS OF WOOD INFECTED, NEWMAN LAKE, WASHINGTON

Year Data Taken	Total Number Cankers	Per Cent of Total Cankers on Wood Produced In:										
		1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
1929	565	0.2	0.0	0.2	1.2	1.9	1.9	11.9	26.4	51.9	4.4	0.0
1930	1,591	0.1	0.0	0.1	0.4	0.9	0.9	5.7	22.6	53.7	15.2	0.4
1931	1,935	0.1	0.0	0.1	0.4	0.8	0.8	5.4	21.8	51.2	17.9	1.5

From these facts it follows that there was a large increase in cankers caused by R. inerme in 1927 and 1928 but no cankers showing which could definitely be attributed to infected R. lacustre in 1929.

From the canker analyses in Table No. 8 has been derived Table No. 10, which shows the distribution of the cankers found each year according to their stages of development.

TABLE NO. 10

DISTRIBUTION OF CANKERS FOUND IN 1929, 1930 AND 1931 BY DEVELOPMENT STAGES, NEWMAN LAKE, WASHINGTON

Year Data Taken	Total Number Cankers	Percentage of Cankers								
		First Symptoms	Juvenile	Current Year Pycnia	One Year Old Pycnia	Fruited Once	Fruited Twice	Fruited Several	Dead	Total
1929	565	60.7	32.0	2.5	0.0	0.5	0.4	2.5	1.4	100
1930	1,591	1.6	51.4	23.3	0.6	17.0	0.2	0.4	5.5	100
1931	1,935	0.0	3.7	5.6	13.8	46.3	6.5	0.4	23.7	100

Because the majority of the cankers studied are of 1927 origin these cankers predominate in Table No. 10. It is seen that the order of canker development from 1929 to 1931 has been from "First Symptom" to "Juvenile" to "Fruited Once". It is apparent that after examination in 1930 most of the juvenile cankers produced pycnia and thereby passed to the fruiting atage in 1931. However, there was a large percentage of the cankers found in 1931 that produced pycnia for the second time instead of aecia.

SUMMARY

1. A total of 2,340 P. monticola, P. strobus and P. flexilis transplants were planted for the purpose of augmenting the study of the disease spreading power of R. lacustre. As a secondary purpose a study of the relative susceptibility of these species will be made.

2. Initial Ribes eradication during 1929 on 45 acres resulted in the removal of 126,884 feet of R. inerme live stem. In 1930 on this same area there were removed 1,012 feet and in 1931 only 516.

3. Weather conditions at the Newman Lake plot compare very favorably with the average conditions throughout the Inland Empire white pine belt.

4. Partially shaded R. lacustre bushes receive and intensify blister rust more readily than bushes in full shade or in the open although those in the full shade do almost as well.

5. Of the total amount of infection on R. lacustre, telia made up 2.4 per cent in 1929, 53.4 per cent in 1930 and 63.9 per cent (maximum) in 1931.

6. With the tremendous increases in aeciospore production there were almost as large increases in the number of infected R. lacustre bushes and a substantial increase in the area over which these bushes were distributed.

7. The number of cankers per infected pine increased from 8.6 in 1929 to 15.1 in 1931. On the basis of the total needle bearing stem target, there were 8.5 cankers per thousand feet in 1929 and 19.4 in 1931.

8. Canker analyses show the majority of cankers to have originated in 1927 and 1928, the last two years that R. inerme was present. By far the largest percentage of these originated in 1927.

9. No cankers were found that definitely originated in 1929, the first year of possible spread by R. lacustre only.

10. The majority of the cankers progressed from first symptoms in 1929 to juvenile in 1930 to fruited once in 1931. First pycnial production probably occurred after examination in 1930.

EDUCATIONAL WORK 1931

By
Kermit Miller
Agent

INTRODUCTION

The educational program of the Western Office, Division of Blister Rust Control, was continued in 1931 along the same lines as in 1930. In Washington and Idaho the program was handled by the project leader. The state leaders in Montana, Oregon and California handled the work in those states, using material supplied by the Spokane office. This report deals only with the work in Washington and Idaho, the work in the other three states being treated in the reports of the state leaders. Educational material was furnished to other states when definite requests were received.

PURPOSE

Educational work has for its major goal the dissemination of information to all interested persons so that the blister rust program may receive the best possible cooperation. Specifically the work is done with five groups: blister rust workers, the Forest Service personnel, timber owners and operators, schools, and the general public. The purpose, therefore, is to give to the blister rust personnel information regarding the progress and results of each project and its relationship to the entire control program; to instill in the minds of all timber owners and operators the menace of blister rust to the continued production of white pine; to establish in the minds of Forest Service officials, timber owners and the general public the necessity of preserving actual and potential timber assets so that white pine may continue as a valuable forest tree; to supply the latest information and working material to forestry schools in order that students may have a working knowledge of blister rust and its control; and to make contact with, and impart some knowledge of blister rust and its control to a portion of the general public not in direct contact with blister rust control work in an attempt to secure interest in and support for the control program.

SUMMARY OF WORK DONE

The educational program falls under three general headings: (a) preparation and distribution of material; (b) distribution of information; and (c) photographic work.

A. Preparation and Distribution of Material

1. Specimens. By actual experience it has been found that the use of specimens of blister rust in all stages combined with informative material i.e., bulletins, pamphlets, etc., is the best method of disseminating

blister rust information. A working knowledge of blister rust cannot be gained without a thorough knowledge of all phases of the disease itself, and this is best secured by the use of illustrative specimens.

Approximately 2,500 Ribes leaves with the uredinial stage of blister rust and 4,000 leaves with the telial stage were collected and pressed for use in mounts. No mounted Ribes specimens were made up in 1931 as a large enough supply was on hand to care for all demands. Thirteen mounts of each stage were sent out to individuals. All interested schools now have specimens for classroom use. In addition, 12 quarts of each stage were pickled for the use of school laboratories. The pickled leaves were preserved in quart jars and one quart of each stage was sent to the University of Minnesota.

A new method of mounting Ribes leaves will be used in 1932. Transparent-front envelopes, having suitable legends for each stage of the rust on Ribes, have been secured from Washington, D. C. All that is necessary to complete the mount is to insert the leaf and seal the envelope. One thousand envelopes for each stage are on hand.

Thirty-six quart jars of cankers showing the five stages of development of blister rust on western white pine were collected in the Puget Sound region of Washington in April. During the year, 362 cankers were preserved in individual test tubes. Of these, 315 were used in demonstration boxes, 11 were sent to schools, and 36 are on hand. Some of the 133 on hand at the beginning of the year had to be discarded due to deterioration. The gelatin medium was used in preserving the specimens, but high-test paraffin was substituted for the common variety as it has a much higher melting point. A number of these specimens were used in local demonstration work.

All specimens sent out were so treated as to preclude the possibility of viable spores or mycelium remaining in the material. At the time of collection all specimens are treated with a killing solution. For pine specimens, the solution is two parts formaldehyde, 10 parts glycerin and 88 parts water. For Ribes leaves it is five parts formaldehyde, five parts glacial acetic acid and 90 parts 50 per cent solution of alcohol. Ribes specimens to be used in laboratory work are preserved in test tubes or quart jars in the killing solution, those to be used in mounts are merely dipped and then pressed, while pine specimens remain in the killing solution until ready for canning in the test tubes. The formula for the gelatin medium in which pine specimens are preserved is: three ounces granulated bacto-gelatin, 30 ounces distilled water, and one ounce formaldehyde.

2. Demonstration boxes. During 1931 only one type of demonstration box was used, a 7-stage box showing both uredinial and telial stages on

Ribes and five stages on pine so arranged as to indicate the life cycle. The specimens are supplemented by a one-page legend covered with celluloid. Sixty-three of these boxes were made up during the year, 24 were sent to state leaders, two sent to private parties, and the remainder was used in the eradication camps and general demonstration work. This box is the most compact and complete piece of demonstration material yet devised. It gives the complete story of the rust and a brief treatise on the methods of control.

3. Blister rust albums. The blister rust albums developed in 1929 and 1930 were not used in 1931, as not enough time was available to assemble a sufficient number of up-to-date copies for the use of all of the blister rust camps.

4. University sets. These sets consist of a series of photographs with complete legends and one copy of each of the blister rust bulletins and are designed for the use of students writing theses, etc. However, when furnishing material for classroom use, these sets are supplemented by one 7-stage box, two tubes each of pickled uredinial and pickled telial specimens and six Ribes mounts of each stage. The legends for the pictures are designed to give all information relative to the life cycle, spread of the rust, ultimate damage to pine, method of control, and work accomplished to date. Fifty-three sets of pictures and legends were sent out in 1931, 50 of them going to the Oregon state leader and three to individual students.

5. Bulletins. Demands from students for information on costs and methods of eradicating wild Ribes in the West led to the writing of a bulletin, "Development of Methods of Eradicating Wild Ribes in the Inland Empire - 1922 to 1930". This was mimeographed and used in appropriate cases, 25 being sent out. S. N. Wyckoff's article, "Blister Rust Control in the Inland Empire", which was published in the Timberman in June 1930, was brought up to date, mimeographed and used as a general bulletin, 949 of which were sent out. The following additional bulletins were used in educational work in 1931:

a. Miscellaneous publication No. 23 - general bulletin dealing with blister rust. 1,263 used.

b. Reprint from The Timberman - "White Pine Blister Rust - Its Cause and Control in the West". 67 used.

c. Miscellaneous publication No. 27 - "Black Currant Spreads White Pine Blister Rust." 213 used.

d. Technical bulletin No. 87 - "White Pine Blister Rust: A Comparison of European and North American Conditions." 58 used.

e. Farmer's bulletin No. 1398 - "Currants and Gooseberries - Their Culture and Relation to White Pine Blister Rust." 213 used.

f. Technical Bulletin No. 240 - "The Chemical Eradication of Ribes." 4 used.

g. Question and Answer lists - mimeographed pamphlet dealing with blister rust and its control. 110 used.

6. Five-winged panels. The panels were used for small gatherings or to supplement other material. They were not revised in 1931.

B. Distribution of Information.

1. Blister rust personnel. Two mediums are employed to distribute information to blister rust workers. The more important of these is "The Western Blister Rust News Letter", published monthly in the Spokane office and edited by the project leader; the other is the monthly personnel meetings.

The News Letter provides an open forum wherein any pertinent question may be discussed. Articles are written on blister rust and allied subjects by all permanent members of the organization, with a few articles coming from outside sources. New or untried methods of work are thoroughly discussed in the News Letter, which is confidential in nature and goes to permanent employees and a few other interested persons. In the July and August issues the material is less technical and nothing of a controversial nature is printed. These two numbers are sent to all temporary and permanent employees. Eleven issues, averaging 12 pages in length, were published in 1931.

Monthly personnel meetings are held the first Wednesday in each month during the winter season. At each meeting, two or three speakers are on the program and an effort is made to have all projects reviewed during the winter. Once each year a personnel conference is held in Spokane and is attended by allwestern blister rust employees. At this conference all phases of the work are discussed and reviewed thoroughly. The 1931 conference was held January 12 to 17.

An attempt is made to have all temporary employees become familiar with the blister rust situation, and to this end a supply of educational material is given to each Ribes eradication camp. This material includes one 7-stage demonstration box and a full set of bulletins.

2. U. S. Forest Service. No organized educational campaign was conducted with Forest Service workers in 1931. However, 15 copies of the mimeographed bulletin "Blister Rust Control in the Inland Empire" were sent to the supervisors of the five national forests in north Idaho. Representatives of the blister rust office attended the Region 1 and Region 5 Investigative Meetings and furnished any desired information.

3. General publicity. Articles dealing with all phases of the blister rust problem appeared in newspapers in Wallace, Kellogg and Moscow, Idaho and in Spokane, Washington. In addition a number of articles were released to the Associated Press and to the Spokane News Service. The former gave the stories general distribution throughout the West in the larger daily newspapers, while the latter sent material to the smaller daily or weekly papers of the Inland Empire.

A window demonstration was used at Wallace and Kellogg, Idaho, in conjunction with the news stories. Illustrated lectures were given before 19 science classes at Lewis and Clark high school in Spokane and one was given before a men's club at the Knox Presbyterian Church.

Demonstrations were given at the Sportsmen's and Tourists' Fair at Spokane in May; the Western Idaho State Fair at Boise, Idaho, September 2 to 5; the Bonner County Fair at Sandpoint, Idaho, September 24 to 26; and the Clearwater County Fair at Orofino, Idaho, September 17 to 19. At all of these places the three large demonstration cases, remodeled in 1931, containing colored pictures under glass, specimens of the disease in all stages and legends explaining all phases of the blister rust situation, were used. To supplement these cases, the automatic slide projector was used showing both picture slides and legends. This machine gives a continuous illustrated lecture and commands far more attention than a speaker. Large trunk cankers, trees killed by blister rust, and Ribes bushes completed the demonstrations. Bulletins were given to all persons desiring them. A demonstration, featuring Ribes eradication equipment and a heavily infected western white pine tree, was given at Headquarters, Idaho where delegates to the Pacific Logging Congress at Spokane attended a special meeting as guests of the Potlatch Forests, Incorporated.

Three radio talks were written by the project leader. The titles were: "The Need for Prompt Action in the Application of Blister Rust Control in the Inland Empire", "Methods of Controlling White Pine Blister Rust in the West", and "Blister Rust Invasion of the West". These talks were turned over to the California state leader to be broadcasted.

C. Photographic Work.

Photographs contained in the files of this office tell the story of the progress of blister rust control and the improvement in working methods since the inception of the work in the West. Each year an attempt is made to secure a complete set of pictures showing the progress of the work on all projects. Photographic work, however, differs from other educational work in that the project leader and H. M. Cowling take pictures of the work in all of the five western states rather than in Washington and Idaho alone. Snapshots taken by other members of the field forces are used in some cases.

During 1931, 181 5" x 7" pictures were added to the files and 34 more of crown density studies were taken by George Luke which have not yet been filed. In addition approximately 25 kodak pictures taken by field forces are used in some cases.

Following is a list of all photographic work done during 1931:

Prints smaller than 5" x 7"	148
Prints, 5" x 7"	1,614
Prints, 8" x 10"	121
Prints, 9" x 11"	68
Copies, 5" x 7"	43
Copies, 8" x 10"	39
Enlargements, 5" x 7" or 8" x 10"	36
Enlargements, 11" x 14"	88
Enlargements, 16" x 22"	114
Lantern slides made	58
Lantern slides colored	58
Enlargements colored	22
Films developed, 5" x 7", field pictures, etc	264
Roll films developed	15
Film packs developed	6
Copies, annual report, 5" x 7"	6
Copies, annual report, 8" x 10"	43
Prints, annual report, 9" x 11"	886

Leica Camera Work for J. M. Chambers

Rolls Leica film developed	13
Contact prints (1-1/2" x 1-5/8")	52
Enlargements, 3-1/2" x 5-1/2"	349

In addition to the work listed above a new photographic field was invaded when H. M. Cowling, in cooperation with the 116th Photo Section, Washington National Guard, made aerial mosaic maps of three areas in north Idaho: (1) the area near Honeysuckle Ranger Station, Coeur d'Alene National Forest where Ribes eradication work was done; (2) the Fishhook Creek infection area in the St. Joe National Forest; and (3) the Long Meadow Creek infection area near Elk River, Idaho. The maps made as a result of this work are to be used by the Ribes eradication and damage to pine projects. This type of map has a very definite value in control work. Cowling also spent five weeks at Crissy Field, the Presidio, San Francisco, California, studying the laying and interpretation of aerial mosaic maps in order to obtain the maximum data from maps made here.

One of the aims of the project since the darkroom was installed in July, 1930, has been to constantly improve the quality of the photographic work. To this and new copy equipment was built in 1931. The Neon floodlights used experimentally during the winter of 1930 and spring of 1931 were found to be deficient in some respects and entirely unsatisfactory for color correction work. For that reason they were turned back to the manufacturers and Mazda lamps put in the large reflectors. These lamps have been found satisfactory for all types of copy work and are now in use.

A new easel was built by the two men in the project early in 1931 to hold large maps, charts, tables, etc., for copying. It is built on a heavy stand and has a copying surface 42" x 60". The front is plate glass set in a hardwood frame while the back is plywood in four removable sections. A heavy cardboard is used to hold the subject in absolute contact with the glass. The easel is mounted on rubber casters and can be conveniently moved.

RECOMMENDATIONS

The darkroom now has all necessary equipment for turning out work in large volume, except a print drier for matte surface prints. This type of print is now dried between blotters, but this method is unsatisfactory and slow. The prints must be changed to dry blotters twice before they are ready for use and all of the blotters must be dried before they can be used again. When making prints for the annual report, the work is necessarily slowed down a great deal by this procedure. It is therefore strongly recommended that a Pako belt drier be purchased.

EXPENDITURES BY THE
WESTERN DIVISION OF BLISTER RUST CONTROL
CALENDAR YEAR 1931

Federal Expenditures

The following tabulations of federal expenditures for the periods January to June, 1931, and July to December, 1931, summarize by projects the expenditures of the Division of Blister Rust Control.

Expenditures have been classed under the several heads shown in the tabulations for the purpose of better analyzing items of expense charged to each project in preparing project cost statements. To further this objective office records show the classification of all expenditures by object.

TABLE NO. 1

FEDERAL EXPENDITURES, WESTERN DIVISION OF BLISTER RUST CONTROL
JANUARY 1, 1931 - JUNE 30, 1931

	Project	Salaries	Expenses	Total	Recapitulation of Expenses: Sub-sistence Expenses	Railroad Fares, Pullman, Stage, etc.	Operation Person-ally Owned Autos	Cost of Transpor-tation in Government Trucks	Other Transpor-tation Expenses	Express, Freight, Trucking and Packing	Supplies and Equipment	Repairs, Rents and Miscel-laneous
2.2	Developing Methods of Ribes Eradication											
	2.22 - Method Studies of Ribes Eradication, Idaho	$5,141.95	$3,100.68	$8,242.63	$242.76	$5.68	$94.57	$11.79	$.10	$274.51	* $2,304.08	$167.19
	2.25 - Experimental Ribes Eradication, California	4,048.71	2,388.59	6,437.30	1,138.55	137.53	158.24	12.14	15.23	54.91	* 745.05	126.94
2.3	Developing and Testing Ribicides and Barberricides											
	2.3-1 - Laboratory Investigations, Ribicides	9,183.07	2,666.07	11,849.14	742.26	461.07	143.01	51.21	11.10	75.56	** 869.59	312.37
	2.3-1 - Laboratory Investigations, Barberricides ***	2,173.86	1,154.19	3,328.05	193.05	174.97	-	30.52	5.20	15.53	468.94	265.98
	2.3-2 - Field Tests of Ribicides	450.00	13.55	463.55	-	-	-	-	-	-	5.49	8.06
2.4	Studies in Ribes Ecology											
	2.42 - Idaho	1,451.17	576.33	2,027.50	149.23	88.03	53.62	31.15	7.77	1.38	138.90	106.25
	2.44 - Oregon	58.33	54.54	112.87	7.95	45.29	-	-	1.30	-	-	-
	2.45 - California	866.64	398.26	1,264.90	146.17	83.10	37.31	20.04	2.34	.88	90.12	18.30
3.1	Control Reconnaissance on Federal Lands											
	3.14 - Oregon	175.00	151.09	326.09	89.98	-	32.90	26.26	-	-	1.95	-
	3.15 - California	1,043.49	558.12	1,601.61	344.39	25.87	27.93	14.61	40.50	42.40	15.92	46.50
3.2	Ribes Eradication on Federal Lands											
	3.21 - Savenac Nursery, Montana	1,035.00	258.95	1,293.95	36.75	11.88	59.08	-	1.40	2.99	141.65	5.20
	3.22 - Clearwater National Forest, Idaho	3,218.99	228.41	3,447.40	122.26	19.99	3.60	29.05	1.00	1.70	27.95	22.86
	3.23 - Wind River Nursery, Washington	90.66	39.77	130.43	38.40	-	-	1.37	-	-	-	-
	3.24 - Mount Hood National Forest, Oregon	475.00	222.98	697.98	26.90	17.50	54.04	-	.35	-	124.19	-
3.3	Ribes Eradication in National Parks											
	3.33 - Mount Rainier National Park, Washington	208.33	77.48	285.81	39.48	15.89	-	-	1.62	2.59	16.60	1.30
3.4	Cooperative Ribes Eradication											
	3.42-1 - Clearwater Timber Protective Association, Idaho #	4,714.11	13,580.20	18,294.31	3,209.31	8.35	3.64	22.10	-	1,132.38	## 8,865.21	339.21
	3.42-2 - Potlatch Timber Protective Association, Idaho #	3,851.98	6,078.24	9,930.22	1,731.73	20.72	66.05	7.86	15.40	698.45	## 3,369.71	168.32
	3.42-3 - State of Idaho and local owners, vicinity Clarkia, Idaho #	1,886.44	4,007.56	5,894.00	744.99	7.00	1.95	23.63	-	397.41	## 2,788.30	44.28
	3.42-4 - State of Idaho, Priest Lake, Idaho #	1,554.16	1,991.12	3,545.28	581.71	-	-	3.80	-	122.82	1,201.15	81.64
4.1	Field Studies Spread of the Rust											
	4.11 - Montana	1,425.00	97.94	1,522.94	26.25	68.04	-	-	2.15	-	-	1.50
	4.12 - Idaho	-	13.71	13.71	-	-	-	-	-	-	-	13.71
	4.13 - Washington	768.33	55.42	823.75	18.00	36.40	-	-	.62	-	.40	-
	4.14 - Oregon	1,524.98	498.28	2,023.26	209.12	74.35	193.27	10.71	2.70	-	1.20	6.93
	4.15 - California	1,950.00	332.60	2,282.60	156.35	110.16	36.05	.60	5.02	6.98	14.10	3.34
4.2	Damage to Pine Studies	4,018.15	1,790.84	5,808.99	607.34	169.39	252.56	69.49	7.33	25.47	* 593.29	65.97
6.	Educational Work, Spokane Office	1,774.98	998.39	2,773.37	122.60	62.40	198.31	-	12.60	18.98	566.54	16.96
9.	Maintenance of Field Office and Miscellaneous Expenses											
	9.1 - Supervision	2,299.98	1,038.84	3,338.82	258.64	639.77	107.94	-	32.49	-	-	-
	9.2 - Office Maintenance	7,920.31	2,227.30	10,147.61	88.30	246.83	-	1.61	3.30	-	-	1,887.26
	9.3 - Miscellaneous Supplies and Services paid on L/A	-	619.43	619.43	-	-	-	46.81	-	23.88	462.89	85.85
	9.4 - Miscellaneous Supplies and Services paid in Washington	-	942.55	942.55	-	-	-	-	-	166.33	776.22	-
	Totals January 1 - June 30, 1931	$63,308.62	$46,161.43	$109,470.05	$11,072.47	$2,530.21	$1,524.07	$414.75	$169.52	$3,065.15	$23,589.44	$3,795.82

*Includes purchases of trucks #6, 8 and 13.
**Includes supplies and equipment for field and laboratory use.
***Expenditures made from $6,500 allotted to this Division by the Division of Barberry Eradication.
See also separate summary of expenditures from cooperators' funds for these projects - Table No. 3.
Outstanding freight and express items for various projects estimated at $50.00 not included in above totals.
Includes purchases of Atlacide and chlorate for 1931 field season.

TABLE NO. 2

FEDERAL EXPENDITURES, WESTERN DIVISION OF BLISTER RUST CONTROL
JULY 1, 1931 - DECEMBER 31, 1931

	Project	Salaries	Expenses	Total	Recapitulation of Expenses: Sub-sistence Expenses	Railroad Fares, Pullman, Stage, etc.	Operation Personally Owned Cars	Cost of Transportation in Government Trucks	Other Transportation Expenses	Express, Freight, Trucking and Packing	Supplies and Equipment	Repairs, Rents and Miscellaneous
2.2	Developing Methods of Ribes Eradication	$5,105.07	$1,509.75	$6,614.82	$804.12	-	$104.90	$10.75	-	$19.62	$269.94	$300.42
	2.22 - Method Studies of Ribes Eradication, Idaho	7,894.77	2,013.49	9,908.26	1,333.45	$22.13	187.05	11.41	$1.30	178.39	239.18	40.59
	2.25 - Experimental Ribes Eradication, California											
2.3	Developing and Testing Ribicides and Barberricides											
	2.3-1 - Laboratory Investigations, Ribicides	7,633.71	3,012.80	10,646.51	1,273.97	97.12	190.77	181.98	5.03	55.03	* 909.04	299.86
	2.3-1 - Laboratory Investigations, Barberricides **	1,319.47	791.17	2,110.64	623.45	31.13	-	38.58	4.05	19.26	26.24	48.46
	2.3-2 - Field Tests of Ribicides	998.34	539.07	1,537.41	446.14	55.46	26.30	1.25	2.40	.90	5.52	1.10
2.4	Studies in Ribes Ecology											
	2.42 - Idaho	2,024.90	996.85	3,021.75	449.03	33.70	146.65	26.61	5.95	7.14	224.87	102.90
	2.45 - California	2,124.96	688.54	2,813.50	410.35	7.31	214.99	.50	2.17	30.71	16.79	5.72
3.1	Control Reconnaissance on Federal Lands											
	3.14 - Oregon	1,977.66	1,108.63	3,086.29	603.21	1.00	378.90	106.14	3.50	-	6.55	10.33
	3.15 - California	2,676.98	636.22	3,313.20	347.24	61.62	29.73	18.38	33.10	78.06	6.44	61.65
3.2	Ribes Eradication on Federal Lands											
	3.21 - Savenac Nursery, Montana	1,464.23	253.61	1,717.84	76.65	3.00	157.85	-	-	3.91	8.00	4.20
	3.22 - Clearwater National Forest, Idaho	11,141.03	912.98	12,054.01	530.22	211.53	-	102.89	19.86	11.00	5.00	32.48
	3.23 - Wind River Nursery, Washington	461.67	170.90	632.57	159.60	-	-	-	-	3.38	7.92	-
	3.24 - Mount Hood National Forest, Oregon	2,961.00	3,904.73	6,865.73	1,671.52	105.65	-	51.76	6.90	344.15	*** 1,721.20	3.55
3.3	Ribes Eradication in National Parks											
	3.33 Mount Rainier National Park, Washington #	1,055.49	357.83	1,413.32	195.26	31.78	75.95	-	1.77	5.21	20.98	26.88
3.4	Cooperative Ribes Eradication											
	3.42-1 - Clearwater Timber Protective Association, Idaho ##	15,655.58	6,356.57	22,012.15	3,838.83	8.85	-	16.81	.05	1,013.09	### 1,175.77	303.17
	3.42-2 - Potlatch Timber Protective Association, Idaho ##	8,179.69	2,964.28	11,143.97	1,811.32	189.32	21.25	20.14	1.02	484.28	291.78	145.17
	3.42-3 - State of Idaho and local owners, vicinity Clarkia, Idaho ##	3,897.64	1,147.88	5,045.52	653.58	-	14.95	4.65	-	329.95	169.06	75.69
	3.42-4 - State of Idaho, Priest Lake, Idaho ##	2,776.74	1,379.78	4,156.52	892.91	.26	63.00	12.60	8.00	82.01	236.19	84.81
4.1	Field Studies, Spread of the Rust											
	4.11 - Montana	570.00	66.49	636.49	30.10	22.69	21.00	-	1.20	-	-	1.50
	4.12 - Idaho	711.66	385.66	1,097.32	254.21	-	131.45	-	-	-	-	-
	4.13 - Washington	155.00	47.85	202.85	27.95	-	19.90	-	-	-	-	-
	4.14 - Oregon	999.99	192.60	1,192.59	107.90	-	14.45	10.01	28.55	5.44	12.16	14.09
	4.15 - California	1,125.00	248.93	1,373.93	134.55	9.89	78.87	18.44	.42	1.60	3.62	1.54
4.2	Damage to Pine Studies	4,945.16	1,958.78	6,903.94	1,346.63	22.37	443.62	66.63	.85	.80	36.17	41.71
4.3	Summarization of Field Data	1,441.67	363.55	1,805.22	96.50	145.19	59.15	-	4.75	5.64	52.32	-
6.	Educational Work, Spokane Office	1,789.98	702.98	2,493.96	145.73	51.79	122.95	58.06	5.25	7.39	273.00	38.81
9.	Maintenance of Field Office and Miscellaneous Expenses											
	9.1 - Supervision	2,299.98	687.64	2,987.62	219.85	441.19	-	-	25.35	-	-	1.25
	9.2 - Office Maintenance	8,051.48	2,534.60	10,586.08	18.55	-	-	1.70	148.12	-	-	2,366.23
	9.3 - Miscellaneous Supplies and Services paid on L/A	-	504.31	504.31	-	-	-	88.12	-	42.43	261.12	112.64
	9.4 - Miscellaneous Supplies and Services paid in Washington	-	586.52	586.52	-	-	-	-	-	136.23	450.29	-
	Total July 1 - December 31, 1931	$101,438.85	$37,024.99	$138,463.84	$18,392.82	$1,552.97	$2,503.68	$847.41	$308.59	$2,865.62	$6,429.15	$4,124.75

*Includes supplies and equipment for field and laboratory use.
**Expenditures made from $4,500 allotted to this Division by the Division of Barberry Eradication.
***Includes cost of 8 tons Atlacide.
Includes cost of control reconnaissance in Mount Rainier National Park.
See also separate summary of expenditures from cooperators' funds for these projects - Table No. 3.
Includes cost of Ford Sedan.
Outstanding freight and express items for various projects estimated at $120.00 not included in above totals.

COOPERATIVE EXPENDITURES

The following table summarizes the expenditure of funds contributed by the Clearwater and Potlatch Timber Protective Associations for cooperative Ribes eradication on their respective areas; by the State Land Department of the State of Idaho, Potlatch Forests, Inc., and the Milwaukee Land Company for such work in the vicinity of Clarkia, Idaho; and by the State Land Department of the State of Idaho for such work in the vicinity of Priest Lake, Idaho.

The cooperators' contributions were deposited as usual as a special account in the U. S. Treasury and were disbursed by the Division of Blister Rust Control at Spokane, Washington.

TABLE NO. 3

SUMMARY OF BLISTER RUST CONTROL COOPERATIVE RIBES ERADICATION EXPENDITURES BY THE CLEARWATER AND POTLATCH TIMBER PROTECTIVE ASSOCIATIONS, THE STATE LAND DEPARTMENT OF THE STATE OF IDAHO, AND THE MILWAUKEE LAND COMPANY AND POTLATCH FORESTS, INC.
JUNE 1, 1931 - SEPTEMBER 30, 1931

Cooperating Agency	Wages	Expenses	Total	Recapitulation of Expenses: Subsistence Supplies	Transportation of Equipment and Supplies	Miscellaneous Supplies and Services
June 1-30, 1931:						
Clearwater Timber Protective Association	$3,827.90	-	$3,827.90	-	-	-
Potlatch Timber Protective Association	2,493.10	$3.33	2,496.43			$3.33
State Land Department, State of Idaho; Potlatch Forests, Inc.:Milwaukee Land Company	-	-	-	-	-	-
State Land Department, State of Idaho	-	-	-	-	-	-
Total June 1-30	$6,321.00	$3.33	$6,324.33			$3.33
July 1 - September 30, 1931:						
Clearwater Timber Protective Association	$13,474.11	$2,603.31	$16,077.42	$2,494.66	$61.01	$47.64
Potlatch Timber Protective Association	6,182.21	1,321.36	7,503.57	1,019.23	299.63	2.50
State Land Department, State of Idaho; Potlatch Forests, Inc.; Milwaukee Land Company	5,039.80	960.20	6,000.00	773.50	183.60	3.10
State Land Department, State of Idaho	4,581.07	418.93	5,000.00	381.90	30.78	6.25
Total July 1 - Sept. 30, 1931	$29,277.19	$5,303.80	$34,580.99	$4,669.29	$575.02	$59.49
Grand Total	$35,598.19	$5,307.13	$40,905.32	$4,669.29	$575.02	$62.82

For Federal expenditures for these projects see projects 3.42-1, 3.42-2, 3.42-3, 3.42-4 on statements of Western Federal Blister Rust Control expenditures, January 1, 1931 - June 30, 1931 and July 1, 1931 - December 31, 1931.

GENERAL SUMMARY

I. Development of Local Control Practice

A. Eradication.

1. California. 17,340 acres on the Lassen National Forest were freed of 340,005 Ribes, an average of 19.6 per acre, at a cost of $11,106.20, an average of $.64 per acre.

2. Idaho.

a. Studies on chemical eradication methods were undertaken to discover the best means of application of Ribicides. Tentative results have shown that a 10 per cent concentration of sodium chlorate is more effective than a 5 per cent concentration when sprayed on the aerial parts. The application of large amounts of common salt to the soil about Ribes crowns demonstrated a possibility for entirely destroying plant life on an area which, however, may not prove a practical method of Ribes suppression. Although copper complex paste injected into the stems, crowns and roots of Ribes proved ineffective, the injection tool itself, designed on the principle of a pair of pliers, was satisfactory; so that it is possible that with a more highly toxic paste, injection methods may prove successful. Atlacide used with a dusting machine seemed to be more effective than aerial spraying on Ribes inerme and R. lacustre, but considerable difficulty was experienced with the machine which became clogged, causing a lack of uniformity in the amount of dust applied. Sufficient time had not elapsed to give results from the following experiments: the use of sodium chlorate and Atlacide for aerial and soil applications in successive treatments; the use of sodium chlorate in solution for soil drenches; individual bush study involving the use of different volumes and concentrations of sodium chlorate applied to aerial and root portions of bushes; and soil application of chemicals in dry form.

b. Studies of hand eradication methods demonstrated that a high efficiency can be secured at a relatively low cost by reworking areas a few days following the first eradication. A one-man crew can obtain an efficiency varying from 10 to 100 feet of live stem left per acre at costs varying from one-fifth to one-twentieth of the first work.

c. Experimental and field equipment were developed or tested which included the following: a tool operating like a pair of pliers for the injection of chemical pastes into plant stems; the Chipman Chemical duster for dusting Ribes with Atlacide; aluminum pack frames; and several models of hand pumps, together with an attachment for maintaining constant pressure at the nozzle. The chemical duster was not satisfactory when used with Atlacide dust.

d. Brush elimination as a means of permanent Ribes suppression. The spraying of Ribes and brush followed by burning proved to be the most efficient work in brush suppression where hand methods were employed. Lopping and scattering and windrowing of brush are included in the same category. A Caterpillar tractor equipped with a bulldozer performed every phase of brush-work more efficiently and economically than it could have been done by hand methods. On moderately wet sites the brush was pushed toward the center of the stream type forming windrows.

Grass seed was sown on areas which had been sprayed and burned or hand cleared which resulted in fair to good stands of grass. Artificial seeding has been the means of rapidly converting dense R. inerme areas into permanent grazing sites.

B. Development and Testing of Ribicides

1. Research work 1930-1931. Investigative work was prosecuted along the following lines: starch and tannin analyses of Ribes; chemical pastes; flameproofing of cloth; design of paste injection tool; the physiological aspect of the toxic effect of low concentrations of sodium chlorate on Ribes; and the morphological characteristics of Ribes leaves.

2. Summary of 1931 field experiments.

a. A recheck of the 1930 experimental plots in Idaho, California and Oregon yielded the following conclusions: The application of toxic substances to cut crowns and stems of Ribes markedly increases the chances for kill by some chemicals beyond the limits achieved by the application of sprays of the same materials to the aerial parts. Arsenic oxide, pitch oil, and salts of such metals as copper and silver were relatively the most effective substances used in these experiments.

Of crown drenches, those in which oils were used on plants having the aerial portions cut away showed the most promise. In Idaho the use of oil sprays in all instances failed to kill a satisfactory percentage of the bushes treated. Copper complex is quite definitely not a Ribicide when applied in the form of an aerial spray. Observations in California indicate that oils are most effective when applied both as a heavy drench to dry soil about the base of the plant and as a thorough spray on the aerial parts. Diesel oil applied to R. roezli apparently has a high degree of effectiveness as a Ribicide.

In Oregon chlorate sprays in all instances failed to effect a satisfactory proportion of R. bracteosum bush kill, although fair live stem kills were nearly always obtained. Indications are that many of the sprays tried are toxic to the plant but that present methods of application are at fault. R. lacustre seems to respond somewhat better to chlorate

sprays than does R. bracteosum, but here again spraying with chlorates did not produce satisfactory bush kills.

b. A recheck of the 1929 experimental plots at Clarkia, Idaho showed a reduction of from 90 to 100 per cent of R. petiolare live stem was accomplished when chlorate sprays were applied on two successive years. Variations between 5 and 30 per cent in the concentration of sodium chlorate in the spray does not materially affect the percentage of R. petiolare live stem reduction when the spray is applied on two successive years. None of the treatments on R. inerme or R. lacustre satisfactorily reduced either the live stem or the number of bushes. During the second year after a single application of spray R. petiolare and R. inerme experienced a further reduction of live stem which was pronounced in the case of R. inerme.

c. Late season observations on 1931 field experiments in Washington and California indicate that ammonium thiocyanate is quite as toxic to plant tissue as chlorate. The principle of soil treatment tried so extensively this year appears at present to offer possibilities for the development of methods of treatment supplementary to those being used at present. The injection of glycerine pastes into plant stems again demonstrated the high toxicity of copper complex to plant tissue, but at the same time seemed to show that this method of application did not provide the proper opportunity for perfect distribution of the chemical to the vital parts of the plant.

C. Barberry Investigations.

1. Summary of 1931 field experiments.

a. Results of the 1930 experiments at Maumee, Ohio showed that Atlacide and sodium chlorate were the only spray chemicals of all those applied that consistently yielded bush kills of higher than 75 per cent; sodium chlorate alone or in combination with calcium chloride resulted in nearly every case in bush kills of 96 per cent or more.

b. Late season observations on 1931 field experiments conducted in Pennsylvania and Colorado revealed that ammonium thiocyanate is quite toxic to barberry. None of the other chemicals that were applied to this work for the first time during 1931 appear to offer any advantages over those that were previously used.

D. Studies in Ribes Ecology.

1. Idaho. Observations on the survival, rate of growth and time of fruiting of Ribes were continued on a much less extensive scale on the controlled plots established in 1927.

Partial results of the Ribes seed storage study gave the following germinations secured from duff samples taken from various age classes of the timber stand: 18 seedlings came from the 20 to 40-year-old stands, 9 from the 40 to 60, none from the 60 to 80, 3 from the 80 to 100 , none from the 100 to 150, 3 from the 150 to 200, and 1 from stands over 200 years old.

A study was undertaken to determine the effects of cutting methods on the germination and survival of Ribes and conifer reproduction by studying in the field such factors as light, moisture, temperature and pH in their relation to Ribes germination and growth. No sound conclusions can be drawn from results obtained from only one season's work of this nature, and it remains for additional studies to be conducted before results of a conclusive nature can be presented.

The laboratory investigations of the factors controlling the germination of Ribes seed were continued in 1931, and yielded the following conclusions: Alternation between 25° C. and 5° C. appears optimum for the germination of R. inerme, R. lacustre, R. nevadense and R. viscosissimum; 25° C. and 10° C. appears optimum for R. petiolare. The most effective germination stimulants are weak solutions of sodium chlorate, weak solutions of sulphuric acid, and, for R. petiolare, the storage of seeds at -10° C. for four and one-half months. Alkaline and neutral peat give best results as germination media. Most species of Ribes seeds need a rest period before germination.

2. California. Studies were initiated in 1931 on the dissemination of Ribes seeds, seed storage in duff and soil, seed germination, viability of seeds when stored under various conditions, and the effect of logging on Ribes reestablishment. No results have been obtained from these as yet. A continuation of the old studies has yielded the following points in addition to those reported previously. Ribes seeds have been found in the top layer of loose needles, in the compacted layer of duff, and in the soil beneath. Seed germination took place prior to May 15 in 1930 and 1931. Part of the seeds of the same fruit may germinate oneyear, and part one year or more later. Stored seed is the source of new bushes on a cut-over area for the first three or four years.

II. Application of Local Control.

A. Control Reconnaissance.

1. Washington. Extensive reconnaissance completed on approximately 85,000 acres on Mount Rainier National Park at a cost of $.0108 per acre.

2. Oregon. Extensive reconnaissance completed on 640,770 acres in southern Oregon at a cost of $.0053 per acre.

3. California. Intensive reconnaissance completed on 91,469 acres on the Klamath National Forest at a cost of $.0401 per acre.

B. Ribes Eradication on Federal Lands.

1. Clearwater National Forest, Idaho. 15,326 acres actually worked at a cost of $9.25 per acre. 70,365 acres were partially protected at a cost of $2.01 per acre.

2. Mount Rainier National Park, Washington. 2,668.9 acres were worked at an average cost of $3.12 per acre for both upland and stream type Ribes eradication.

3. Wind River Nursery, Washington. There were 376 acres worked at an average cost of $1.98 per acre. This was a combination of initial Ribes eradication and reeradication.

4. Still Creek, Mt. Hood National Forest, Oregon. 535.3 acres were worked at an average cost of $13.75 per acre. Approximately 130 acres of this were worked for the first time and the remainder was reeradication.

C. Cooperative Ribes Eradication.

1. Idaho.

a. Clearwater Timber Protective Association. 7,440.9 acres of stream type worked at a cost of $7.60 per acre. 52,530 acres were protected at a cost of $1.08 per acre for the degree of protection afforded by stream type Ribes eradication.

b. Potlatch Timber Protective Association. 1,599 acres of upland type worked at an average cost of $3.46 per acre and 3,349.4 acres of stream type worked at an average cost of $6.61. 33,960 acres were partially protected by stream type Ribes eradication at a cost of $.81.

c. Priest Lake Timber Protective Association. 11,068.1 acres were worked at a cost of $1.18 per acre. This area includes upland and stream type Ribes eradication.

d. Upper St. Maries River. Agencies cooperating with the Division of Blister Rust Control were the Milwaukee Land Company, Potlatch Forests, Inc., and the State of Idaho. 6,430 acres were worked at an average cost of $2.75 per acre. This includes both stream type and upland Ribes eradication.

D. Checking Efficiency of Ribes Eradication Work.

1. Idaho. Checking was done on the Potlatch and Clearwater timber protective associations and on the Clearwater National Forest. On the assumption that reduction of Ribes to 50 feet or less of live stem per acre constitutes protection, 2,142.5 acres or 53 per cent of the area checked met this standard. On the Potlatch Timber Protective Association 100 feet of live stem left in 1929 amounted to 140 feet in 1930 and 145 feet in 1931. On the Clearwater Timber Protective Association 100 feet of live stem left in 1929 increased to 194 feet in 1930 and to 305 feet in 1931.

III. Field Studies of the Rust.

A. Spread of the Rust.

1. New pine infections.

a. Idaho. 45 new centers of pine infection were located; 24 on the St. Joe National Forest, 2 on the Coeur d'Alene National Forest, one on the Clearwater National Forest, 4 on the Coeur d'Alene, 7 on the Potlatch and 7 on the Clearwater timber protective associations.

b. Washington. One new pine infection center found in Mount Rainier National Park. A new pine infection was found within a half mile of the Wind River nursery.

c. Oregon. The only new pine infection center located is in the Mount Hebo plantation on the Siuslaw National Forest.

2. New Ribes infections.

a. Washington. Infections were found on Ribes in northeastern Washington at four points in Stevens County and nine points in Ferry County.

b. Oregon. Infections located at 21 points, none of which mark a further extension southward than reported in previous years.

B. Pine Infection Studies.

1. Deep Creek, Idaho. This center was started in 1923. The area studied consists of 15.4 acres where 7.8 per cent of the pines are infected with 1.8 cankers per infected tree. In 1929 the feet of live stem per acre was 1,562 of R. lacustre and 10,938 of R. petiolare. In 1931 there were 427 feet of R. lacustre and 188 feet of R. petiolare live stem per acre. A study reveals that 6 cankers originated in 1923, 11 in 1926-1927, 971 in 1928 and 1 in 1930.

2. Long Meadow Creek, Idaho. A study was conducted on 51 acres of this infection where the disease entered in 1923. An examination in 1929 showed that 11.3 per cent of the pines were infected while in 1930 there were 27.7 per cent infected. In 1929 there were 14.3 cankers per infected tree and in 1930 there were 9.9 cankers. Originally there was a maximum of 1,881 feet of R. lacustre and 27 feet of R. viscosissimum live stem per acre which was reduced to 10 feet of R. lacustre and 2 feet of R. viscosissimum live stem per acre in 1931. No canker analysis has been made which would show year of origin of cankers.

3. Ruby Creek, Idaho. Infection started here in 1923. A study applied to 132.4 acres shows 33.8 per cent of the pines infected with 13.2 cankers per infected tree. The amount of Ribes probably causing initial infection is estimated to be approximately 5,331 feet of R. petiolare, 238 feet of R. inerme, and 1,611 feet of R. lacustre live stem per acre.

4. Deer Creek, Idaho. This infection of approximately 12 acres started in 1923 and in 1930 showed 3 per cent of the pines infected with 1.8 cankers per infected tree. There were 69,610 feet per acre of R. petiolare live stem in 1929 and 49 feet of live stem per acre in 1930. Canker analysis shows that one originated in 1923, 311 in 1927-28, and one in 1929.

5. Fishhook Creek, Idaho. Infection originating in 1923, extends over an area of at least 100 acres. A survey of 22.35 acres resulted in an estimate of 650 feet of R. petiolare, 20,004 feet of R. lacustre, 591 feet of R. irriguum and 23 feet of R. viscosissimum live stem per acre. 40.4 per cent of the pines are infected with 4.4 cankers per infected tree.

6. Newman Lake, Washington. Canker analyses show the majority of cankers to have originated the last two years that R. inerme was present. No cankers were found that definitely originated in 1929, the first year of possible spread by R. lacustre only. The number of cankers per infected pine increased from 8.6 in 1929 to 15.1 in 1931. On the basis of total needle-bearing stem there were 8.5 cankers per thousand feet in 1929 and 19.4 in 1931.

7. In order to study pine infection occurring on areas where Ribes eradication has been performed and also to gather information on the relative susceptibility of pine species, certain plantations were established. On the Clearwater Timber Protective Association there were 4,897 pines planted, of which 58 per cent were P. monticola and 42 per cent were P. strobus; on the Potlatch Timber Protective Association there were 4,322 pines planted of which half were P. monticola and half were P. strobus.

At Newman Lake, Washington there were 2,340 trees planted, 40 per cent each of P. monticola and P. strobus and 20 per cent were P. flexilis. Due to a protracted period of drought only about 45 per cent survival is indicated.

IV. Educational Work.

Educational work was carried on with Blister Rust personnel, Forest Service personnel, timber owners and administrators, educational institutions and the general public. Information was disseminated by the use of demonstration material, talks and papers, and a monthly news letter.